

WAVES



YEAR IN REVIEW
2020



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Chief of Naval Operations Adm. Mike Gilday visits Naval Surface Warfare Center, Carderock Division's Maneuvering and Seakeeping basin in West Bethesda, Md., on Feb. 4, 2020. (U.S. Navy photo by Devin Pisner)

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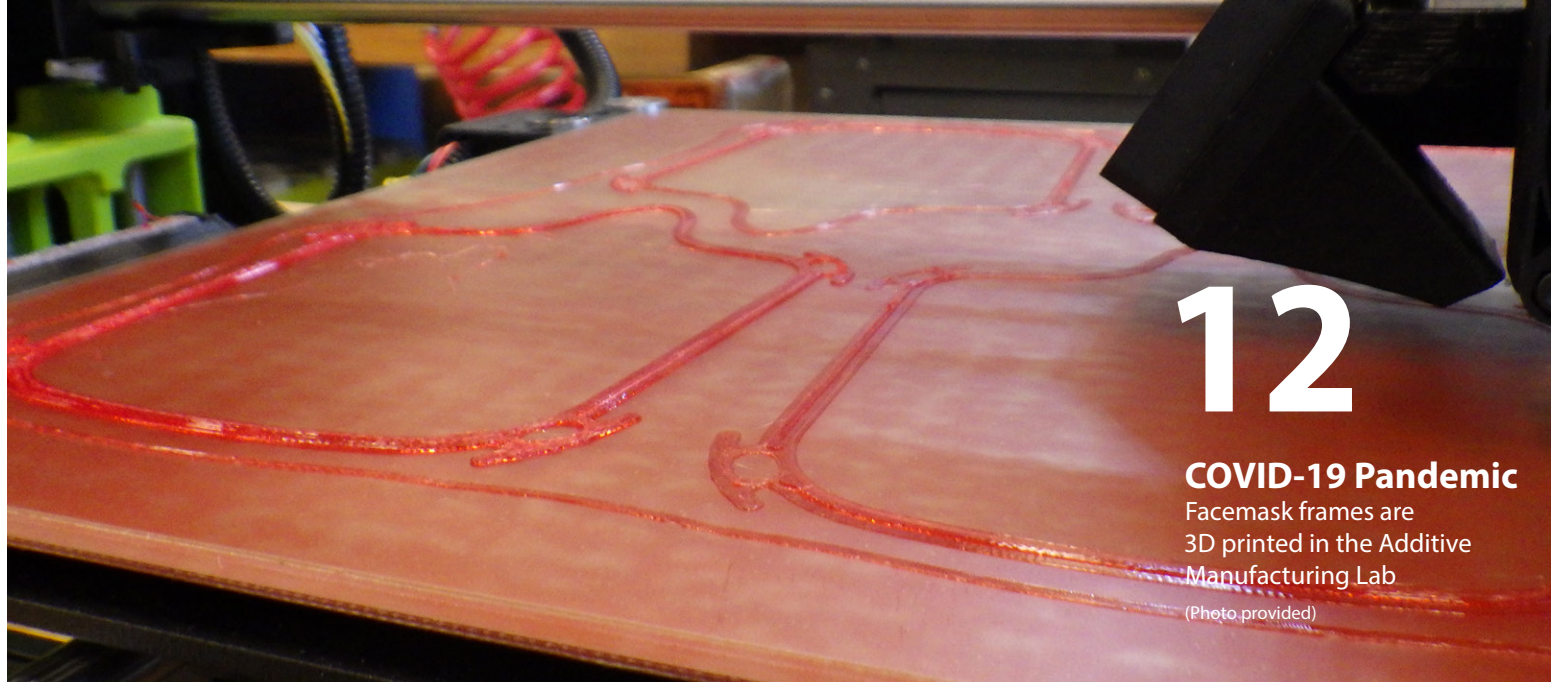
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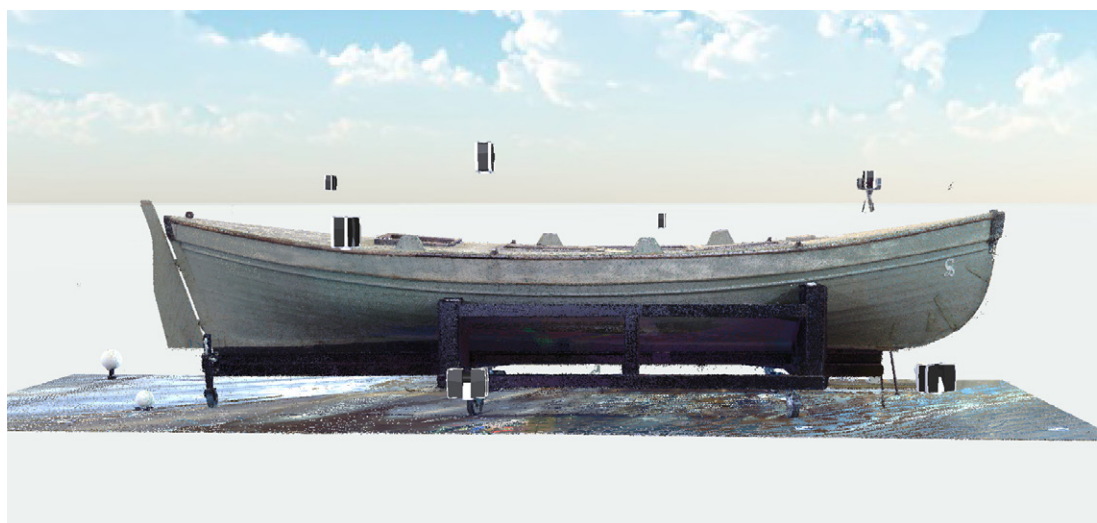


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COVID-19 Pandemic

Facemask frames are 3D printed in the Additive Manufacturing Lab

(Photo provided)



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USS Saginaw

A cropped, preprocessed scan of USS Saginaw's surviving gig, with locations of the scanner positions.

(Scanned image provided by Scott Ziv)

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Technical Director's Cup

Team Goose Busters' robot enters the obstacle course on Sept. 17, 2020, at Naval Surface Warfare Center, Carderock Division's Olney Support Center in Olney, Md.

(U.S. Navy photo by Edvin Hernandez)



It's been a little while since we issued a Waves. The year 2020 was a somewhat tumultuous year. However, while some things may have been put on the back burner (like Waves), Carderock still had a very successful year. In this issue of Waves, we highlight some of those accomplishments.

COVID-19 was obviously a big part of our year. We fought through it, and in some cases worked with other Warfare Centers and departments to come up with creative ways to get masks and hand sanitizer to our employees, as well as outside entities. There are several stories in Waves about our people's tenacity during the pandemic.

Of course, the work must go on. Even in this strange time, our Carderock team stepped up to perform the work necessary to meet the mission. Across all of our departments: Platform Integrity, Signatures and Naval Engineering and Hydrodynamics, as well as our Detachments, this is a great example of the dedication and resiliency of our folks.

Carderock Division had a number of patents issued, and while many of those had been applied for in previous years, it's still a great success when an invention is recognized with a patent. There are several examples in this Waves of those successes.

We also changed command last year, welcoming Capt. Todd E. Hutchison as Capt. Cedric McNeal went on to a program office.

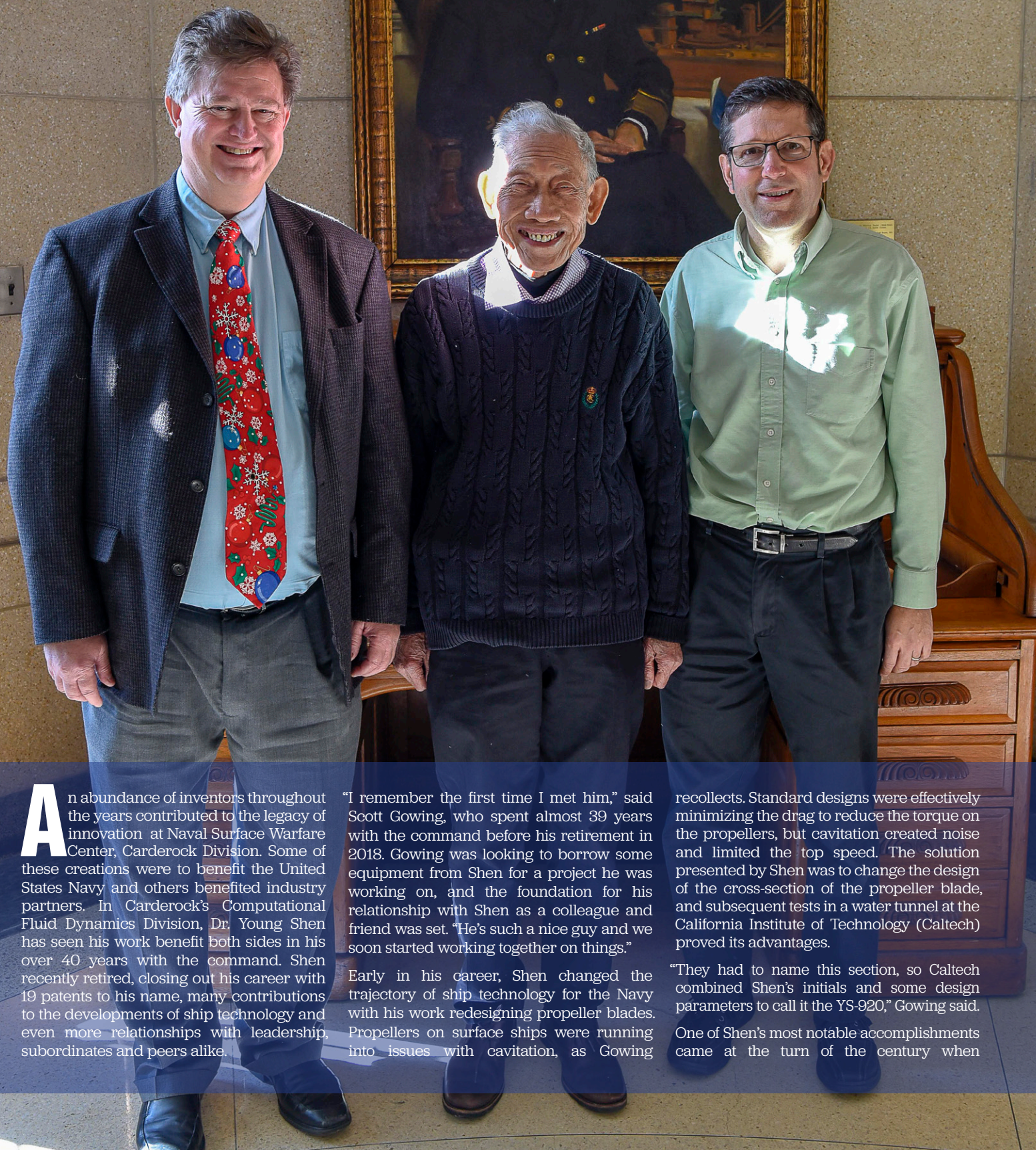
As your Technical Director, I'm always incredibly proud and humbled to share the Carderock family's excellence with others. There are some very significant events from last year highlighted, so I sincerely hope you enjoy this issue of Waves as much as I do. Stay tuned for another Rockstar edition that will capture the successes of specific individuals and teams in 2020.

Thank you

Larry Tarasek

Naval Surface Warfare Center, Carderock Division engineers David Hess, Dr. Young Shen and Michael Hughes share a moment together in Shen's final week with the command at West Bethesda, Md., on Dec. 11, 2019. Shen retired in January after over 40 years at Carderock.

(U.S. Navy photo by Harry Friedman)



An abundance of inventors throughout the years contributed to the legacy of innovation at Naval Surface Warfare Center, Carderock Division. Some of these creations were to benefit the United States Navy and others benefited industry partners. In Carderock's Computational Fluid Dynamics Division, Dr. Young Shen has seen his work benefit both sides in his over 40 years with the command. Shen recently retired, closing out his career with 19 patents to his name, many contributions to the developments of ship technology and even more relationships with leadership, subordinates and peers alike.

"I remember the first time I met him," said Scott Gowing, who spent almost 39 years with the command before his retirement in 2018. Gowing was looking to borrow some equipment from Shen for a project he was working on, and the foundation for his relationship with Shen as a colleague and friend was set. "He's such a nice guy and we soon started working together on things."

Early in his career, Shen changed the trajectory of ship technology for the Navy with his work redesigning propeller blades. Propellers on surface ships were running into issues with cavitation, as Gowing

recollects. Standard designs were effectively minimizing the drag to reduce the torque on the propellers, but cavitation created noise and limited the top speed. The solution presented by Shen was to change the design of the cross-section of the propeller blade, and subsequent tests in a water tunnel at the California Institute of Technology (Caltech) proved its advantages.

"They had to name this section, so Caltech combined Shen's initials and some design parameters to call it the YS-920," Gowing said.

One of Shen's most notable accomplishments came at the turn of the century when

A LOOK BACK THE LEGACY OF CARDEROCK'S DR. YOUNG SHEN

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

hydroplane races were highly popular. The Anheuser-Busch-sponsored Miss Budweiser boat was a dominant competitor since its beginnings in 1962, but looked to reach higher speeds as the end of the century approached. Their team reached out to Frank Peterson who at the time was an engineer in the Hydrodynamics Department to take their request to Shen. What Shen discovered was that the way the boat operated allowed for a new skid-plate design.

In the summer of 1999, the Miss Budweiser boat debuted his new skid plate during the Budweiser Columbia Cup in Tri-Cities, Washington, and set a course record of 163.451 mph according to an email to Shen from Boeing engineer Derrick Rogers. Success continued with another course record at Lake Okanagan in British Columbia two weeks later. On Sept. 19, 1999, Miss Budweiser set a world lap-speed record in San Diego, California, at 173.384 mph.

"I took personal satisfaction to witness that the new concept works as demonstrated by Miss Budweiser," Shen said to Rogers. "We are very happy that we were able to make a contribution to the success of the team."

Shen's skid plate made the Miss Budweiser boat so dominant that by 2002, racing authorities banned the design from competition.

"I think the Miss Budweiser story is a great reflection on his creativity," Gowing said.

What might be Shen's most renowned innovation was the Twisted Rudder, a patented design to alleviate cavitation noise and erosion damage on rudders of the Arleigh Burke-class guided-missile destroyers (DDG 51). Aligning the rudder section to the inflow was a simple, yet effective concept, and it eventually transitioned to the fleet. Later on, he added a tip plate innovation for delaying tip vortex cavitation to the design. The plate design came from observing cavitation in the 24-inch Water Tunnel on a rudder model and modifying the plate with a file and its final shape was determined in one day.

Shen's forward thinking continued to stand out well into the new millennium. While best



the division met their desired outcome until Shen developed a scaling formula that would help engineers determine what the size of the coating should be on the models.

Hughes teamed up with Shen to get a patent on further scaling research, receiving one in 2017 for "Ship-Resistance Prediction Using a Turbulent Spot Inducer in Model Testing." This work concentrated on creating the appropriate turbulent flow about the model in order to provide a more accurate prediction of the full-scale resistance.

Dr. Young Shen at Naval Surface Warfare Center, Carderock Division's Large Cavitation Channel testing in 1991 in West Bethesda, Md. Much of Shen's most notable work dealt with solving cavitation problems for surface ships, including the patenting of the twisted rudder

(Photo submitted by Scott Gowing)

known for work on surface ships, he delved into the world of undersea vessels in the back end of his career. That is when Michael Hughes in the Carderock's Hydrodynamics and Maneuvering Simulation Branch and David Hess in the Submarine Maneuvering and Control Division crossed paths with Shen. "When I first started working with Shen, I found out that he was a very careful researcher," said Hess, who has known Shen for around 10 years. "When he was beginning a new problem, he would perform a literature search and learn as much as he could about the problem from all appropriate sources."

According to Hess, Shen was the reason for their division's revamped method for scaling model vessels that more accurately reflected their full-scale counterparts. At the time, the division was looking for a way to make their submarine models emulate a full-scale submarine's maneuvering behavior when they ran trials, primarily in the re-creation of a vessel's non-skid coating. They lacked a standard to ensure

"I think that's how he came up with more innovative things," Hughes said. "Our tendency a lot of times is to say, 'OK, we have standard operating procedures for how we do things,' and we get stuck on that. He'd sort of always start from scratch and come up with theories, which is how he came up with different ideas."

Those who have worked with Shen throughout the years know there is a void his retirement has left. After four decades of service under Carderock, his efforts have left a lasting impact on countless people in and outside of the Navy.

"He was a wizard, which is a funny thing to say because when you think wizard, you think a guy that can do magic," Hess said. "Of course, it wasn't magic but sometimes it looked like that because of his depth of knowledge. We need people like that who have the depth of knowledge in several different disciplines and can draw from that to create solutions that are more complex. He's not an easy guy to replace, and we will miss him."

WEAPONS, CCAT LOOK AHEAD WITH ELEVATOR PRESERVATION

By Mass Communication Specialist Seaman Anton G. Wendler, USS Stennis (CVN 74)

Many departments and teams aboard the aircraft carrier USS John C. Stennis (CVN 74) have assisted in the ship's pre-Refueling Complex Overhaul (RCOH) progress.

The ship's weapons department corrosion team and the Corrosion Control Assistance Team (CCAT) from Naval Surface Warfare Center, Carderock Division's Corrosion and Coating Engineering Branch worked together to complete the preservation of lower stage weapons elevator (LSWE) 3 on June 22.

"The strength in numbers made this task much more efficient," said Lt. Bryan Silva, a division officer for the ship's weapons department. "The goal was to safely preserve the elevator pit and set a new

standard for carrier elevator preservation and maintenance."

With instruction and guidance from CCAT, the weapons department utilized multiple techniques in order to execute a successful preservation of LSWE-3.

"The weapons department conducted removal of rust and damaged coatings using needle guns, deck grinders and abrasive pads as well as applied all coats of paint," said Silva. "CCAT provided training, oversight, and guidance at each step and ensured that all personnel understood the process to achieve first time quality."

The corrosion prevention on LSWE-3 will allow weapons department to approach all other weapons elevators with the training and experience provided by this first evolution. Preserving the elevator now will allow it to be used during the RCOH process and ensure that the John C. Stennis gets back into the fight, on budget and on schedule.

"All weapons elevators are important in regards to their functionality, accessibility and usage throughout the ship," said Lt. Cmdr. Lawrence Schaffer, the ship's ordnance handling officer. "LSWE-3 was the first elevator pit where the training and understanding the scope of corrosion prevention started for our team. Completing LSWE-3 pit corrosion prevention saves time and critical man hours that could impact RCOH timelines and delivery schedules."

CCAT is a Naval Sea Systems Command (NAVSEA) Ship Integrity and Performance Engineering Group (SEA 05P) program funded by the Painting Center of Excellence (PCoE) with the tasking to provide corrosion control Training, Technical assistance and Tools, and to facilitate the Transition of new technology (known as the 4T's) to Sailors aboard U.S. Navy ships for corrosion control maintenance

projects. CCAT provides support in nine locations in Virginia, Florida, Washington, California, Hawaii, Spain and Japan.

Jim Wigle has been leading the CCAT program within NSWC Carderock Division's Corrosion and Coatings Engineering Branch as the in-

service engineering agent at Carderock since 2010 and is supported by a project engineer, Brittany Preston-Baker, and a Contracting Officers Representative, Connie Hall.

Wigle said the team's goal is to train the Sailor to maintain their ship, which

obviously is subject to severe weather and ocean environments, and these conditions lead to corrosion and therefore metal loss, if not properly controlled.

"The Sailors are doing the work; our guys are providing the technical assistance,

U.S. Navy Sailors perform preservation on a lower stage weapons elevator aboard the aircraft carrier USS John C. Stennis (CVN 74) in Norfolk, Virginia, May 11, 2020.

(U.S. Navy photo by Mass Communication Specialist 3rd class Jarrod A. Schad)



training and support that's required to do it right, and new technology," Wigle said. "It's basically a ship self-help program."

COVID 19 has not slowed down the support provided by CCAT. While additional measures have been implemented to promote both CCAT and Sailor safety, successful efforts like Stennis have continued to be executed across all of our locations. All members of the CCAT teams wear masks when performing duties, training is conducted topside and in groups of ten or fewer, the CCAT team members maintain social distance when providing over the shoulder training, tools are sanitized prior to lending to the ships and they maintain active communication with ships in order to participate in contact tracing. In FY19, CCAT serviced 274 ship availabilities supporting ships force efforts to preserve over 605,000sqft.

CCAT is on track to support a similar level of effort by the fleet in FY20. Ultimately, CCAT improves material readiness, total ownership costs and self-sufficiency.

The John C. Stennis is partnering with Newport News Shipbuilding to complete Refueling Complex Overhaul on schedule with a trained, resilient and cohesive crew.

(NSWC Carderock Division Public Affairs contributed to this story.)

Two-part epoxy coating applied to a lower stage weapons elevator dries aboard the aircraft carrier USS John C. Stennis (CVN 74) in Norfolk, Virginia, June 22, 2020.

(U.S. Navy photo by Lt. Bryan Silva)

CCAT is on track to support a similar level of effort by the fleet in FY20. Ultimately, CCAT improves material readiness, total ownership costs and self-sufficiency.

CARDEROCK HELPS PRESERVE CENTURY OLD ARTIFACTS WITH 3D SCANNING CAPABILITIES

By Edwin Hernandez, NSWC Carderock Division Public Affairs



The Naval History and Heritage Command (NHHC) holds a collection of valuable artifacts, each one containing a unique chapter of U.S. naval history. In August, NHHC contacted Naval Surface Warfare Center, Carderock Division in West Bethesda, Maryland, to support 3D scanning of USS Saginaw's surviving gig, which is a small whaling boat generally used as the captain's taxi.

Saginaw was an active ship during the American Civil War, but was grounded after striking an outlying reef near Midway Island in 1870, 150 years ago. Five volunteers embarked in the gig on a one month, 1,500-mile mission to find rescue for the 88 stranded members of the crew. Only one of the five, William Halford, made it to the coast of Hawaii alive, but after getting word to the king, the crew was saved. Today, Saginaw's surviving gig is housed at NHHC's collection management facility in Richmond, Virginia.

In a collaborative effort to support the 3D-scanning mission of the gig to commemorate the 150th anniversary of its voyage, Carderock engineers Scott Ziv, Ryan Fisher and Anthony Brock teamed up with Combatant Craft Division engineers Ryan Evanko and Roseller Lim. Combatant Craft Division is a detachment of Carderock located at Little Creek-Fort Story Joint Expeditionary Base, Virginia.

The team used two FARO-Focus S70s and one FARO-Focus X330 to capture the exterior and interior of the gig. Target spheres were placed around the hull to align and stitch the scans together, and a higher detail FARO Arm was used to record the finer, smaller details on the boat.

"It took us about three hours to scan the 35-foot vessel," Ziv said. "We had a short tour of the warehouse at the beginning, and after NHHC saw how quickly we were scanning the gig, they brought out more artifacts for us to scan."

A pipe given as a gift to Adm. Arleigh Burke, a wooden crocodile, a spyglass and several other small items were selected for the team to scan with the FARO Arm. According to Ziv, however, processing scans is not as easy as it sounds.

"Whenever people think about 3D scanning they think they get an exact copy of the model," Ziv said. "The truth is that it's never really like that because there are some places the scanner cannot get to, like a crevice or cavity. 3D scanners capture features, and there is a lot of approximation that goes into it. Once you take the scans, you get a point cloud of

Naval Surface Warfare Center, Carderock Division engineers Ryan Fisher (bottom) and Ryan Evanko (top) use a FARO Arm 3D scanner to capture names carved into USS Saginaw's surviving gig's wooden hatch coamings.

(U.S. Navy photo by Scott Ziv)

what you can see. Then it goes to another software where you can mesh that data, erase faulty data, patch holes you can't reach, or stitch multiple scans together. As the engineer, you need to be able to understand what is and is not an important feature in the object you're trying to scan."

Ziv said he was surprised to learn that museums showcase only a small fraction of their collection; and he credited NHHC for exploring a new way to display naval history. When the scan of the surviving gig is finished processing, it will appear online for public access and viewing. One of NHHC's creative future options includes a virtual-reality experience, which would allow online visitors to view the hull in a full 360-degree rotation.

"Museums don't have enough space to display their entire collection at any one

USS Saginaw's surviving gig on a stand at Naval History and Heritage Command with a FARO 3D S70 3D scanner. The white spheres surrounding the hull are known, common points that help align separate scans to one another.

(U.S. Navy photo by Scott Ziv)

“One of the biggest benefits to Carderock is that this capability shows and builds on our technical expertise.”

time. What you see is typically less than 20% of what they actually own," Ziv said. "This was the NHHC Curator Branch's first attempt to digitize some of their artifacts, which will survive longer than their physical presence. Initially, I think one of the command's goals is to establish a 3D web viewer, but there are also other opportunities to share these artifacts with the public. Whether it's a dinosaur or a boat or a missile launcher, you don't really realize how big something is until you stand next to it, and that opens the door - possibly - to virtual reality. What does a museum of the future look like?"

Although 3D scanning capabilities are relatively new to Carderock's Additive Manufacturing Branch, they have been a constant practice for the command's Performance and Evaluation Branch. Brock, who has plenty of experience in 3D scanning, played a pivotal role in supporting space planning efforts at Carderock in a more remote environment.

Brock and Fisher were tasked with scanning Building 9 to capture facilities data and

USS Saginaw's gig rests on a steel mount at the Naval History and Heritage Command's collection management facility in Richmond, Va.

(U.S. Navy photo by Jeffrey Bowdoin)



INNOVATION
AT WORK

dimensions for future equipment additions and space renovations and support expansion planning for the Manufacturing Knowledge and Education (MAKE) Lab.

"Part of the restructuring at Building 9 was for the Platform Integrity Department," Brock said. "They were looking to acquire new equipment, and they wanted a good idea of the space in the facility to plan for the new machines coming in. So, we scanned the area, which took about two days, and stitched all the scans together to create a floor plan and simulation of the available space."

Brock, much like Evanko, Lim and Fisher, is well-versed in 3D scanning. Ziv, on the other hand, is developing his knowledge in the field and said this experience benefitted him and the command in several ways.

"One of the biggest benefits to Carderock is that this capability shows and builds on

our technical expertise," he said. "Technical excellence is easy to say, but hard to prove until you go out and do something like this, leverage your skills to make a lasting change, and strengthen our relationship with our partners."

Another benefit for Carderock, according to Brock, has been networking with Combatant Craft Division.

"It is nice to have additional points of contact for scanning resources," he said. "If we have a big project in the future, it is good to know we have people who can help us support the mission."

While the COVID pandemic continues to linger across the United States, it did not prevent Carderock engineers from preserving storied pieces of naval history and helping the public experience them from home.



CARDEROCK ENGINEERS ROAD TRIP TO SAN DIEGO TO CONDUCT CALM WATER TRIALS

By Edwin Hernandez, NSWC Carderock Division Public Affairs

A group of engineers from the Naval Architecture and Engineering Department at Naval Surface Warfare Center, Carderock Division drove nearly 3,000 miles to Naval Base San Diego to perform calm-water trials on USS Zumwalt (DDG 1000) in April.

The test, which is part of the Performance and Special Trials (P&ST) program for the

class, was managed by Carderock engineers. Test results will be used to develop baseline performance information for the class to support safe and efficient operation. The trials included evaluations of powering, fuel consumption, tactical, maneuvering and machinery performance. The P&ST program for DDG 1000 also includes two phases of testing in heavy weather, which

focuses on evaluating mission operability and crew and ship safety.

Initial performance trials for DDG 1000 began in December 2018 with the first round of calm-water testing, which focused on lower-to-moderate ship speeds. Both phases of the calm-water trials were conducted near San Clemente Island, close to the ship's homeport of San Diego.



The guided-missile destroyer USS Zumwalt (DDG 1000) departs San Diego as part of an operational underway, March 8, 2019.

(U.S. Navy photo by Mass Communication Specialist 2nd Class Natalie M. Byers)



"The testing is performed under benign environmental conditions with calm seas and low winds," Senior Trials Director Stephen Minnich said. "San Clemente Island is just offshore from San Diego, and we take advantage of its lee to shield the ship from as much of the prevailing wind and wave environment as we can."

On March 27, Minnich received a call from the Zumwalt-class Destroyer Program Office (PMS 500). He was asked to conduct a calm-water trial, which was initially scheduled for later in 2020. A test team was established on short notice including Minnich, naval architect Doug Griggs, electrical engineer Brian Chirozzi and computer engineer Tim Rancourt from NSWC Philadelphia Division. Unlike the 2018 calm-water trial, engineers were now focusing on the ship's high-speed performance.

Since the COVID-19 Pandemic has forced state-wide lockdowns and stay-at-home orders, traveling presents some difficulty. However, Navy personnel are considered essential employees, so the team debated the safest way to get to San Diego. The team concluded that driving a rental vehicle - a 12-passenger van - was the best option to avoid the potential danger of contracting the virus.

"We made a collective decision, from a safety perspective, not to fly commercial," he said. "Our priority was to limit our exposure, so we determined that driving cross-country was preferable in that we would have more control over potential infection than in an airport or onboard a plane."

Engineers from Naval Surface Warfare Centers, Carderock and Philadelphia Divisions meet in the lobby of their hotel on April 6, 2020, in San Diego. From left: Senior Trials Director Stephen Minnich, computer engineer Tim Rancourt, electrical engineer Brian Chirozzi and naval architect Doug Griggs.

(Courtesy photo)

The traveling engineers faced a race against time after it was learned that any test rider from outside the ship's homeport would have to self-quarantine in San Diego for at least 72 hours before going aboard.

"We were racing against the clock," Minnich said. "We left the following Wednesday morning and we had to be checked into our hotel by Saturday morning. To get there in time, we drove three days straight for about 15 to 16 hours each day and arrived in San Diego late that Friday night."

During their quarantine in the hotel, the team was impacted by the new Navy requirement to wear face-coverings if they were unable to maintain more than six feet of distance between one another.

"All of the ship riders and crew were required to wear face-coverings, because when you're in a shipboard environment, you are in close quarters with many people," Minnich said. "We were in this challenging situation, because we were in self-isolation, but we also needed to obtain face-masks. Luckily, the wife of one our team members sewed us some masks and sent them via Priority Mail."

Carderock and NSWC Philadelphia Division also provided support to the team of engineers by sending hand sanitizer, gloves and facemasks, all of which are a luxury during the COVID-19 Pandemic.

"Help from both commands was much appreciated," Minnich said. "We were stuck in a situation where we were not supposed to go out in search of that gear - because of our self-quarantine - and of course all of those supplies are limited in general, but we were able to persevere with the help of many folks back home."

After a month's long journey - including about 6,000 miles of driving - Minnich and

his team returned home to West Bethesda, Maryland, on April 28.

"We were able to complete all of the planned testing, which was a huge win. The ship was able to support everything we were testing, and it enabled us to finish all the calm-water test conditions for the ship, which is a major milestone," he said.

Minnich also praised the team's overall preparation, which he believes enabled them to be successful in their mission on the West Coast.

"What allowed us to be so successful with this test was the extensive planning and preparation," he said. "One of the things we did, given all the travel restrictions and changing policy, was to prepare detailed test procedures that the crew could utilize to conduct the trial in case we could not make it out there. Translating our normal procedures into a way that a Sailor, who has no prior experience of our testing, could understand and execute was a nice win that came out of the planning effort."

After receiving positive feedback from the crew aboard DDG 1000, the test team expects to incorporate similar planning strategies and procedures for future test events.

“We were in a race against the clock...To get there in time, we drove three days straight...”

CARDEROCK FIGHTS COVID-19 PANDEMIC

Facemask frames
are 3D printed in the Additive
Manufacturing Lab on April 10, 2020,
at Naval Surface Warfare Center,
Carderock Division in West Bethesda, Md.
The frames were used for face coverings
during the COVID-19 pandemic.
(Photo provided)

CARDEROCK TEAM USES TALENTS TO MANUFACTURE COVID-FIGHTING TOOLS

By Todd Hurley, NSWC Carderock Division Public Affairs

The Materials and Manufacturing Technology Division at the Naval Surface Warfare Center, Carderock Division has been instrumental in supporting local COVID-19 pandemic response efforts, from hand sanitizer production to critical supplies. Four members of Carderock's Additive Manufacturing Branch have been fighting the COVID-19 pandemic in a unique manner - with the use of 3D printers.

Since March, Justin Artis, mechanical engineer, Josh Duck, technician, Zach Heinkel, composite materials engineer and Scott Ziv, mechanical engineer, have been using 3D printers to create three separate tools to be use during the worldwide pandemic - facemasks, visors and a flattened, hook-shaped door opener to be used in place of physically touching door handles.

With the majority of the prioritization for health-related supplies being given to hospitals and other medical facilities, these four individuals decided to put their advanced manufacturing talents to use in the best way they knew how.

"One of the biggest challenges during this pandemic is protecting yourself, and it's made harder since you can't effectively buy the supplies needed anymore. We looked to answer the COVID needs very quickly, and determined what we thought to be the most efficient way to help out," Heinkel said. "We didn't want to mass produce items, though. We just wanted to step up and do our part and make quality items, and I think that's really unique."

The process began in March when they received a request from the Marine Corps for face shields. This kicked off their efforts, and it did not go unseen. After the success of the face shields, Larry Tarasek, Carderock's technical director, requested 3,000 facemasks. By early May, the idea for the door opener had been formed. To date, they have created roughly 1,500 of their door openers, with a goal of 3,000. These door openers, and the facemasks, will be part of a personal protection kit to protect employees working on site.

"The door openers are interesting because the end products we're making are not actually printed, they're casted out of urethane, but we use 3D printing as a tool to aid the process," Ziv said. "We 3D printed the original 'blanks,' used them to make a silicone mold, then poured urethane in to make the final part. This lets us keep the turn-on-a-dime agility of 3D printing, while having the capacity and consistency of mass production."

Door openers that allow less personal contact with door handles are ready to be sanded in the Manufacturing Knowledge and Education (MAKE) Lab at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md., on June 9, 2020.

(U.S. Navy photo by Scott Ziv)

They were assisted by materials and manufacturing subject-matter experts, including Anna Bernal and Joe Korczynski of Carderock's Non-Metallic Research and Engineering Branch, who produced 125 units and provided valuable insight into the urethane casting process.



The door opener, which can be used to open most doors, including handicap accessible doors, is flattened, with a much lower contact area than a person's hand, and helps reduce transmission and contact exposure when opening a door. They also have a feature for pushing buttons on keypads, elevators or other high-touch locations.

"While it doesn't eliminate the risk, it considerably lowers it, and every little bit counts," Ziv said.

The group spent two full weeks working on the door openers, while creating approximately 250 per day. The entire process to make a set took anywhere from 20-30 minutes, while 10-15 of those minutes revolved around waiting for the urethane resin to cure while filling up another set. Each set consists of nine door openers.

They also spent most of April producing, packaging and preparing the facemasks, and collaborating with Carderock's warehouse for distribution. In June, they created 75 visors in a 72-hour timeframe at Carderock's Manufacturing Knowledge and Education (MAKE) Lab, to deliver to Naval Sea Systems Command (NAVSEA) headquarters for COVID-related testing.

While the four of them are relatively new to Carderock - Ziv having the most seniority at just over two-and-a-half years - they all come from more than capable backgrounds. Ziv and Artis have bachelor's degrees in mechanical engineering from Virginia Tech and the University of Maryland, respectively. Artis also worked at the Naval Air Station Patuxent River for nearly four years before transferring to Carderock. Duck has a bachelor's degree in electrical engineering technology from the State

Josh Duck, a mechanical engineer in the Additive Manufacturing Branch at Naval Surface Warfare Center, Carderock Division, pours urethane into a mold to make a new set of door handles on June 10, 2020, in Carderock's Manufacturing Knowledge and Education (MAKE) Lab in West Bethesda, Md.

(U.S. Navy photo by Justin Artis)

University of New York at Farmingdale; and Heinkel has bachelor's degrees in physics and composite material engineering from the University of Wisconsin-La Crosse and Winona State University in Minnesota, respectively. Heinkel also served in the Air National Guard for six years.

CARDEROCK SCIENTISTS TACKLE HAND SANITIZER SHORTAGE

By Benjamin McKnight III, NSWC Carderock Division Public Affairs



Jay Ong, a chemical engineer in the Corrosion and Coatings Engineering Branch at Naval Surface Warfare Center, Carderock Division, mixes the ingredients for hand sanitizer in the lab in June 2020.

(Photo provided by Jay Ong/Released)

One of the earliest words of guidance to come from the entities such as the World Health Organization (WHO) and Center for Disease Control (CDC) at the beginning of the COVID-19 pandemic was how important it is for people to keep their hands clean.

As the situation progressed from slightly concerning to severely important, retailers across the nation were not prepared for the mass purchasing of sanitation products. Hand sanitizer was one of the most popular purchases and by the middle of March, many stores and online shops were completely out of stock. Since then, those who have been able to refill their supply have put limits on how many bottles can be purchased at one time, while many listings on websites such as Amazon are still on backorder.

Engineers and scientists at Naval Surface Warfare Center, Carderock Division who are dealing with the impact of sanitizer shortages have been enlisted to help handle demand. With the idea originally stemming from the efforts of Deniz Ferrin and Cody Matheson of Puget Sound Naval Shipyard (PSNS) and Intermediate Maintenance Facility (IMF), Jay Ong of Carderock's Corrosion and Coatings Engineering Branch is leading an effort to produce hand sanitizer for the command's use. The group is following the World Health Organization's procedures for local production, a guideline that has been out since April 2010.

The effort started small with the production of 10, 1-liter bottles and has since grown. After becoming an officially registered Food and Drug Administration (FDA) producer of Ethanol-based hand sanitizer, Carderock can now make the hand sanitizer for the command in 50-milliliter and 1-gallon packaging. Since production began, Ong said they have made over 1000 units.

"Although handwashing is definitely the preferred method, one of the things that we also recognize is that handwashing is not always available or practical," Ong said.

During the course of the pandemic response, a number of groups at Carderock are finding creative ways to fight the shortage of essential equipment. Some of the materials Ong and his counterparts are using are in a higher demand now, but still easier to come by than sanitizer that has already been made and packaged.

"That was actually one of the first rabbit holes we went down," Ong said about the challenge of purchasing sanitizer in bulk.

Hand Sanitizer is being made in a lab at Naval Surface Warfare Center, Carderock Division in June 2020.

(U.S. Navy photo by Jay Ong/Released)

Ong said that industry is catching up, but you have to be cautious as some hand sanitizers aren't registered with the FDA, are not of the right alcohol content to be effective against COVID-19 or cannot be bought in bulk reliably.

The four ingredients in the solution are ethanol, hydrogen peroxide, glycerol and distilled water, all of which are United States Pharmacopeia (USP)-grade materials to ensure a high quality product is made. Every batch of sanitizer goes through a series of quality control checks right after it is produced and before it is packaged. WHO standards require these sanitizers to have an 80% by volume concentration of ethanol with an acceptable deviation of 5% higher or lower. All of the Carderock-

“The hand sanitizer is primarily being used in the travel kits, but it can always be requested through the chain of command.”

produced batches produced thus far have fallen between 80-84% according to Ong.

Planning the execution of this task began almost immediately after the initial stay-at-home orders were given in mid-March. By April 14, the first batch of sanitizer was complete. The time in between was spent validating the process, procuring the materials and creating a standard operating procedure that would identify the most effective means of completing the process. One of the biggest challenges faced in this task was securing adequate packaging to distribute sanitizer.

INNOVATION AT WORK

"A tremendous amount of time was spent trying to identify a container that could be placed in the travel kit, meet TSA restrictions, and effectively dispense the hand sanitizer," Ong said. "Many of the small fine-mist bottles or pumps were just not available for the same reasons that Germ-X and Purell were not available."

Now on their third iteration of packaging, Ong said the group has finally hit the mark. Version one's bottles had a screw top he compared to that on a Sriracha sauce bottle and the second version used a disc cap one would normally find on a lotion bottle.

"Version three is really where we're hitting our stride," he said. "We have these airless sprayers that are working exceedingly well and are refillable which is nice for continuous use. It's a nice, elegant long bottle that you can put in your pocket while doing daily operations."

Help with the production effort has come from all parts of the command, as Ong said individuals regularly volunteer to help with labeling and packaging the sanitizer. The hand sanitizer is primarily being used in the travel kits, but it can always be requested through the chain of command. On top of this effort, Carderock's Corporate Operations has been working to procure more wall-mounted dispensers, refills and additional sources of supply as Carderock is nearing the Phase I of returning to worksites.

With the spread of COVID-19 has come a new normal for people across the globe. At Carderock, the "norm" was always to find an innovative solution to a problem, a fact that remains true as this pandemic continues.



CARDEROCK LOOKS TO USE R&D ABILITIES IN COVID-19 FIGHT

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

The first case of COVID-19, or the Coronavirus, in the United States was discovered in late January and since then has taken a stronghold on the day-to-day operations of the nation. The number of identified Coronavirus cases in the United States now exceeds all other countries as governments and medical experts race towards a solution.

A handful of engineers at various Navy Labs, including Naval Surface Warfare Center Carderock Division in Bethesda, Maryland, are looking to use their knowledge and creative tools to assist in coronavirus relief efforts in their corners of the country. Medical response organizations are seeing

widespread shortages in equipment such as masks, face shields, ventilators and other critical items with the severity of the virus increasing. However, some individuals whose primary objective is to outfit the United States Navy and Marine Corps with high quality tools believe they could leverage their knowledge to help bridge that gap.

“In crises like this, the local response is the most important,” said Dave Newborn of Carderock’s Maritime Aviation and Unmanned Underwater Systems Division. “Being able to understand local needs and problem sets and responding to those in a local fashion.”

Following that line of thinking, Newborn and others decided to form the NSWC Carderock COVID-19 Additive Manufacturing Rapid Response Team. For almost a month, the group has gathered together every weekday to discuss new ideas and plans of action to support entities within their communities. Other Warfare Centers, such as Indian Head and Crane, have joined the effort to compile concepts and inspire more possibilities among one another. Collaborative efforts are also extending beyond the naval enterprise according to Dr. Krista Michalis, who serves as Carderock’s liaison to the NavalX Tech Bridge team.

“Carderock has many types of advanced manufacturing capabilities to include additive manufacturing both metal and plastics, and a talented workforce that we’re leveraging to partner with our innovation ecosystem in Montgomery County and the state of Maryland to support the COVID-19 response,” she said.

Zach Heinkel, an engineer in the Additive Manufacturing Branch, watches an extrusion bead of a 3D printer as it makes a facemask frame on April 10, 2020, in the Additive Manufacturing Lab at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. The frames were used for face coverings during the COVID-19 pandemic.

(Photo provided)

Much of the work to date have been theories, conceptual designs and some experimentation. However, the command’s Additive Manufacturing Branch recently fulfilled a request from the Marine Corps for printed face shields that will be used by a hospital in Colorado in the coming weeks, proving that the capability to provide is there.

However, one of Carderock’s greatest contributions to this COVID-19 fight is through research and development, using

INNOVATION AT WORK

its expertise in specific areas. As described by Dr. Cynthia Waters, there will need to continue to be a degree of coordination that includes more players than just Carderock. A need for those linked relationships is imperative to ensure proper guidance for equipment needs are given and met in the manufacturing process as well as to give the scientists time to adequately test their ideas.

“We have experience with materials and product characterization. We look at the qualifications and then certify parts that have been made by the 3D printing process,” said Waters, the SSTM for Advanced Manufacturing Materials at Carderock. “If you’re going to put a 3D printed part over your mouth and expect for it to filter away viral particles, then we want to make sure that we’re not doing harm by the polymers possibly off gassing deleterious chemicals or compounds to the wearer of the device.”

A series of reports from Italy highlighting the country’s use of additive manufacturing technology to help combat shortages in healthcare equipment also inspired the team’s formation, but Newborn said that contributions are going beyond just additive manufacturing. The idea is not to be constrained to additive manufacturing or some other process, but to leverage what Newborn has been spearheading to provide a solution based on what is available. Right now, though, the goal is to turn those beliefs into affirmations, which means more brainstorming, researching and testing for solutions.

When the solutions phase approaches, Waters said she hopes that Carderock’s response team can provide innovative templates and work with the Food and Drug Administration and Veterans Affairs to help organizations like America Makes, which is a public-private venture that will help innovators to a requirement.

“Those relationships are about understanding what the FDA and VA are seeing as problems and how Carderock’s capabilities can be applied to those problem sets,” Newborn said.

There is no telling how soon the fight against COVID-19 will end. Each day, many challenges face those on the front lines of the battle, especially when it comes to having the proper equipment to protect themselves. Scientists within the Navy are, like many other industries, starting to turn their focus towards stopping the spread of the virus in hopes that their areas of expertise can address issues that others may not.

“This is a war,” Waters said. “It’s not against another human adversary, but certainly it’s one that’ll affect our safety in the United States and the entire world.”

CARDEROCK ENGINEER ASSISTS INTERNATIONAL FIGHT AGAINST COVID-19

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Being a member of the military often requires personnel to be able to adjust to the needs of a new mission on short notice. To some degree, the same is required of its civilian employees, such as Naval Surface Warfare Center Carderock Division's Milton Perez-Cruz, who went to Spain for one job and ended up doing another.

Perez-Cruz normally works as a mechanical engineer in Carderock's Ship Structures Branch. As part of an internal rotation with the Additive Manufacturing Branch, he took an assignment supporting the Forward Deployed Regional Maintenance Center (FDRMC) Detachment Rota in Spain to assist them in completing the set-up of the newly installed advanced manufacturing shop and to support its future Additive Manufacturing (AM) efforts. In fact, upon his arrival in December, he was doing those things.

Much like the rest of the world, the threat of COVID-19 has shifted the focus of the detachment and, in turn, Perez-Cruz's mission. On one hand, he is still supporting the Spanish AM efforts. Originally, those tasks included identifying parts, tools and fixtures to support the mission of FDRMC Rota, continuing the training and best practices for the advanced manufacturing equipment, and collaborating with the Spanish Armada. The last task is still happening, but for a different purpose; utilizing AM tools to provide personal protective equipment alternatives to healthcare workers in that part of the country.

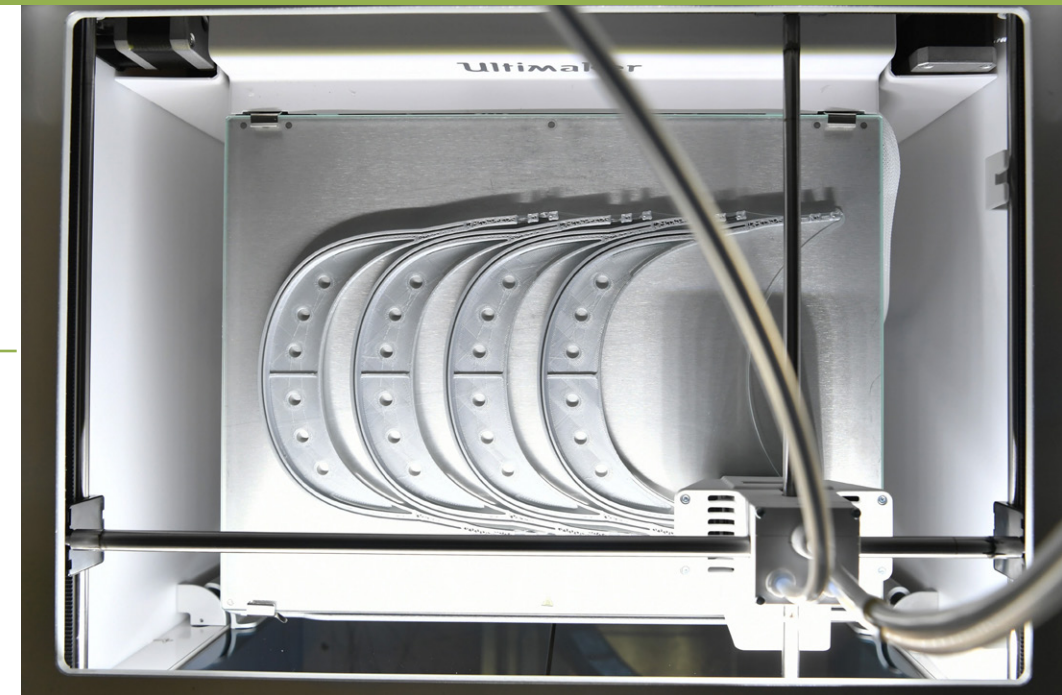
"The efforts started with the engineers of the Spanish Armada, with whom we share our AM facility," said Perez-Cruz, whose rotation is being funded by Naval Systems Engineering Directorate Technology Office (SEA 05T) under Naval Sea Systems Command. "Everything started to take place rapidly."

Perez-Cruz and his counterparts are not shying away from the challenge. With his knowledge in the AM realm, he has played a key role in preparing their lab into a production facility by creating an efficient system of production, troubleshooting machines and sharing updates on their progress with the local command. It is a far cry from the shipbuilding process he originally signed up for, and working through the problem sets presented by the Coronavirus outbreak has pushed the envelope on what Perez-Cruz knows about the AM process.

Day-to-day operations are heavily dependent on Perez-Cruz fostering a positive and productive relationship with his Spanish counterparts, one that he said is flourishing. That mutual understanding helped all parties involved make the necessary shift from vehicle-focused operations to PPE production. The culture of the workplace has shifted to ensure that while he and the others are making equipment to keep the medical professionals safe, they too are remaining safe.

“Navigating a global pandemic was not the conditions under which Perez-Cruz expected to be spending his time overseas.”

Naval Surface Warfare Center, Carderock Division's Milton Perez-Cruz and his coworkers use the Ultimaker S5 3D printer to produce face-shield frames before assembling the face shields in April 2020. As part of their local COVID-19 response efforts, engineers in the Additive Manufacturing Lab at the Forward Deployed Regional Maintenance Center Detachment Rota, Spain, have shifted their focus toward alleviating personal protective equipment shortages for medical professionals in the community. (Photo provided by Milton Perez-Cruz)

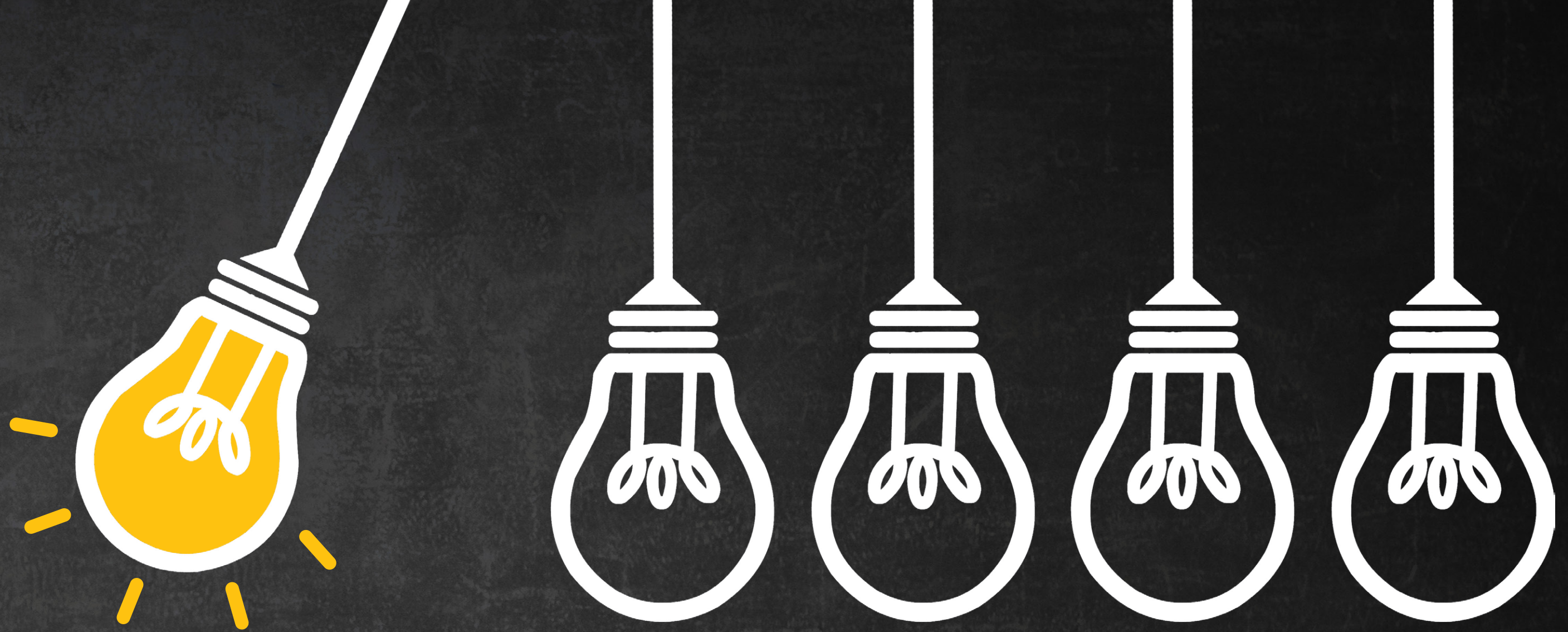


"I would say our biggest challenge has been to adapt ourselves mentally to come in an abnormal environment where we need to be mindful of our health and strictly follow all safety measures and recommendations," he said. "The local community knows about our efforts and has been more than grateful and amazed with our contribution."

Navigating a global pandemic was not the conditions under which Perez-Cruz expected to be spending his time overseas. There is no predicting when Coronavirus will begin to go away, which subsequently impacts when Perez-Cruz could return to Carderock. He regularly talks with his family and friends who are stateside to help keep a high level of motivation.

"Them being far away and not being able to be with them at this moment of crisis really keeps me going," he said. "I know that there are people back home fighting to take care of them, and I realized that with my contribution, I can help other people's families and loved ones, as well."

Miguel Angel Garcia (left), a Spanish Armada functionary; Milton Perez-Cruz (center), a mechanical engineer from Naval Surface Warfare Center, Carderock Division; and David Sanchez, a Spanish Armada engineer, assemble face shields produced in their additive manufacturing lab at the Forward Deployed Regional Maintenance Center Detachment Rota, Spain, in April 2020 for use at local hospitals during the COVID-19 pandemic. (Photo provided by Milton Perez-Cruz)



**PATENT
SPOTLIGHT**

PATENT SPOTLIGHT

SOLAR PANEL DEPLOYMENT METHOD

By Todd A. Hurley, NSWC Carderock Division Public Affairs

A team from Naval Surface Warfare Center, Carderock Division received a second patent for their solar panel deployment technology, a product that was created in 2009. U.S. Patent No. 10,804,839, Solar Panel Deployment Method, was issued on Oct. 13, and is a division of U.S. Patent No. 10,024,579, Solar Panel Deployment System, which was awarded in 2018.

This solar panel deployment technology is legally dichotomized into two categories: an apparatus for collecting solar energy (U.S. Patent No. 10,024,579) and a method for collecting solar energy (U.S. Patent No. 10,804,839). While the disclosures are the same, the earlier patent defines claim coverage in terms of apparatus, whereas the later patent defines claim coverage in terms of method.

Responsible for the invention are Eric Shields, head of Carderock's Battery Certification and Integration Branch, Evan Rule, a power systems engineer in the Expeditionary and Developmental Power and Energy Branch, as well as former Carderock employees Clint Govar, Anthony Suggs and Richard Hardy. Howard Kaiser, associate counsel for intellectual property in Carderock's Office of Counsel, was the patent attorney for this application process.

Enclosed in the original patent was a solar collection method that was comprised of an

apparatus including: two U-bars, two solar panels and a case - a way of making sure the panel did not break upon getting to the field. Meanwhile, the second patent included the batteries and the electronic components - ensuring everything worked properly.

"The solar panels would be worthless without the system," Rule said.

The original patent, invented in 2009 but not officially awarded until 2018, was created at Carderock for deployment to Afghanistan to mitigate risk and reduce logistical fuel burdens on deployed troops. The original product was utilized in correlation with Ground Renewable Expeditionary Energy Systems (GREENS), which uses the panels, rechargeable batteries and power electronics to provide anywhere from 300-500 watts of continuous electricity.

"We received direction from the Office of Naval Research to get solar power out into the field for our outposts," Rule said. "There was an urgent need to get fuel convoys off the road as they were a very big target and responsible for a significant number of casualties at the time."

The process of formal development to getting the product to the field typically takes anywhere from six to 10 years. However, with this urgent request, the Carderock team was able to have their product to the field within two years.

"The original intent was that you had these combat outposts which hosted anywhere from three to 10 Marines with all of their communications equipment - the capabilities that the infantry Marines needed to stay in touch with the rest of the world," Rule said. "The vision was to have these solar panels plopped onto the hill tops to power their equipment so they wouldn't need the fuel convoys."

During those two years of development, seven prototypes were created and sent to Afghanistan, which was responded to with user feedback on how to enhance the product - something that is over a decade in the making.

"Something that's really interesting is that we designed the first solar panel deployment method of the GREENS," Rule said. "While the original solar panel method is no longer used in the current GREENS model, it is pretty neat to be part of the team that designed the first one."

The product of the second patent, which has been in use for several years before getting awarded, came as some surprise to its inventors.

"When we got word that we had been awarded the second patent, I was in shock," Rule said. "It had been off my radar for so long that I had forgotten about it."

The prototype systems for the patents were built at Carderock, but have since been contracted out to a private company.

"For a long time, it was definitely a place to stop during tours on base," Rule said of the time when they were building the prototypes at Carderock.

U.S. Marine Corps Cpl. Robert G. Sutton, left, and Cpl. Moses E. Perez, field wireman with Combat Logistics Regiment 15, install new solar panels on Combat Outpost Shukvani, Helmand province, Afghanistan, Nov. 19, 2012.

The solar panels were installed to provide power to radios and computers in the event of power outages.

(U.S. Marine Corps photo by Lance Cpl. Alexander Quiles)



PATENT SPOTLIGHT

DR. TITOVICH PATENTS A WAY TO MEASURE ATMOSPHERIC INFRASOUND

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Low frequency sound - infrasound - in the atmosphere travels over vast distances carrying information about its source and the state of the atmosphere. To date measurements of infrasound have been restricted to earth's surface.

Dr. Alexey Titovich, a research scientist at Naval Surface Warfare Center, Carderock Division, saw this as an opportunity to research an avenue of implementing infrasonic wave detection on aircraft. In his time within the command's Structural Acoustics and Targeting Strength Branch, Titovich worked on related projects when he realized that the Navy could benefit from such equipment. Almost four years ago, he began an investigation into how the Navy could utilize infrasonic sensors on aircraft and in July 2019, was granted a patent for, "Atmospheric infrasonic sensing from an array of aircraft" (U.S. Patent No. 10,365,089).

"The underlying uniqueness of this sensor is that although scientists have made fiber optical interferometers for measuring infrasound on earth, no such measurement of infrasound has been achieved in the atmosphere," Titovich said. "Researchers have attempted measuring infrasound in the atmosphere with a microphone-like point sensor. The idea here is to combine the benefit of distributed sensing that fiber optic interferometry gets you with a very large spatial aperture provide by the platform."

The issue with a point measurement of infrasound, according to Titovich, is incoherent noise such as pseudo-noise. He said a more effective way of measuring low frequency waves in the atmosphere is with a distributed sensor that cancels out the incoherent noise. Waves that originate from sources that are more distant become harder to detect because they decay as they propagate away from the source. One of Titovich's goals in his research included creating a lower noise floor for the sensor, increasing the distance from which infrasonic activity can be detected.

Dr. Alexey Titovich, a research scientist at Naval Surface Warfare Center, Carderock Division.



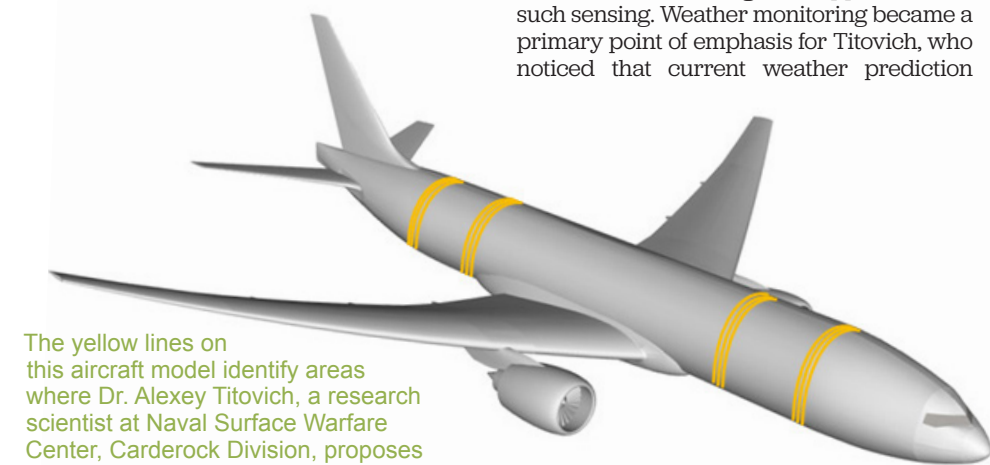
In the beginning of his experimental process, Titovich participated in the development of a fiber optic sensor through a Small Business Innovation Research project for structural health monitoring. While analyzing an odd blip in the test data, he realized and proved that it was due to a very small earthquake over 350 miles away, which piqued his interest in discovering new applications of such sensing. Weather monitoring became a primary point of emphasis for Titovich, who noticed that current weather prediction

technologies could benefit from infrasonic measurement, which unlike LIDAR captures the vibrational state of the atmosphere. Particularly, infrasound generated by severe weather phenomenon such as tornadoes can be localized earlier than with traditional weather warning systems, which has the potential of saving lives.

"The weather aspect to me was absolutely interesting," he said. "Severe weather events that cause infrasound, why would the Navy care about that? Because we either have to sail or fly through it."

Getting the sensor on aircrafts is the next big step for Titovich's invention, and it is a step that is sure to take some considerable time. Following the disclosure for this patent, he worked with Dr. Joseph Teter, Carderock's Director of Technology Transfer, to participate in the FedTech program, where he met with labs and industry representatives to gauge interest in his idea. Other steps to refine the sensor are taking place, such as working to utilize the structural vibrations of the aircraft and the impact of altitude and temperature on the sensors' accuracy.

"One of the things we identified through the FedTech program was those corporate partners and government labs that were interested in pursuing this further," Titovich said. "It needs development and next level demonstration, so we'll be working on that."



The yellow lines on this aircraft model identify areas where Dr. Alexey Titovich, a research scientist at Naval Surface Warfare Center, Carderock Division, proposes infrasonic sensors should be placed to best utilize the piece of equipment.

(Photo illustration provided by Dr. Alexey Titovich)

PATENT SPOTLIGHT HIGH STRENGTH STEEL WELDING CONSUMABLE

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Welding is a highly delicate process that depends on a very specific set of variables for the end product to be effective. A team of engineers that included Naval Surface Warfare Center, Carderock Division engineers Matthew Sinfield and Jeffrey Farren were issued a patent for their work in developing a metal solution that could help meet one of those detailed standards in welding work.

Sinfield and Farren, from Carderock's Welding Processing and Nondestructive Evaluation Branch, assisted in the research and development of a filler metal system that could be used over a wide range of fabrication conditions. The final product was the "High Strength Welding Consumable Based on a 10% Nickel Steel Metallurgical System" (U.S. Patent 10,384,315), which was awarded on Aug. 20, 2019.

When they began their careers at Carderock, both Sinfield and Farren began welding filler metal research and development almost immediately, working with now-retired Carderock engineer Richard Wong on various prototypes. Like with any early stages of an investigation, they found as many problems as they did success points in their work.

"The original 10% Nickel steel filler metal was based on a base metal chemistry that was not optimized for welding," Sinfield said. "It didn't have the right proportions of oxidizing elements such as manganese and silicon, and the carbon was too high to have good weldability."

After more formulations and techniques were tested, Sinfield, Farren and Wong transitioned from using in-house technologies

to industrial practices and processes to create a more potent, transitional solution. A Cooperative Research and Development Agreement was formed with an industry partner, Carpenter Technology Corporation, and the company encouraged the group to file a patent for the work they produced. The group teamed up with eight other engineers from Carpenter Technologies to take their efforts further: William J. Martin, Richard H. Smith, Shane Para, James E. Heilmann, Paul M. Novotny, Patrick C. Ray, Dan DeAntonio and Joe Stravinskis. When the patent was awarded, it was exclusively licensed by Carpenter Technologies.

The team's main goal was to develop a high-strength steel filler metal that would be cooling-rate insensitive with respect to weld metal strength and toughness, and have a low susceptibility to cracking.

"Typically, as strengths in a weldable steel systems increase, the window of operability (i.e., susceptibility to cooling-rate) gets smaller and smaller," he said. "The welding filler metal chemistry tolerances become much tighter, which makes it difficult to manufacture consistently."

According to the patent, achieving both high strength and good toughness in steel welds with a yield strength above 100 kilopounds per square inch (KSI) has been historically difficult. For legacy consumables such as MIL-120S and MIL-140 type high strength steel welding electrodes, the rate at which metals cool result in a specific microstructure that dictates the material properties. With those types of metals, there is a narrow range for cooling rates that are suitable to achieve the desired microstructure and weld metal

properties. By using the 10% Nickel solution, Sinfield said that end products will have more consistency in their microstructure and properties over a range of cooling rates and welding parameters

Metal testing is far from inexpensive and Sinfield said that the decision to get an industry partner for this project was as much about mitigating costs as it was having access to industrial scale technology to turn the theory into a reality. Having an industry collaborator in the development also lends itself to having a ready-made transition partner. Development of the optimized formulation was not an overnight operation either, as the filler metals often took six months to a year to produce, and that is before testing. Sinfield believes that the use of this metal solution could be beneficial in a handful of arenas, from ship building and joining of armor steels, to additive manufacturing field and whatever uses industry partners like Carpenter Technologies can find.

"In order to get the filler metal into the commercial market, we need to generate relevant data for broad industrial applications," he said. "There needs to be a vetted database of mechanical and material properties that designers and fabricators can reference to determine whether or not they want to take a risk on using a new material."

In addition to Sinfield, Farren and Wong, other Carderock engineers and technicians contributed to research of this technology including Daniel Bechetti, James Hayden and Johnnie DeLoach, as well as retired employees Gene Franke and Richard Benzel. Over the years, the work has been funded by contributions from both Office of Naval Research and Naval Innovative Science and Engineering programs.

"It behooves us (the Navy) to help insert new materials of interest into the commercial market to accelerate risk mitigation and further characterize the material as concurrently work to adopt it for naval applications," Sinfield said. "For the insertion of new materials, we're always in this bit of the chicken or the egg scenario coupled with an associated aversion to risk. Having more commercial users that have experience with the alloy will only help us in the end to develop these material databases and buy down that early adoption risk."

PATENT SPOTLIGHT CHEVRON RIBBON FAIRING APPARATUS

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Accounting for water resistance on below-surface vehicles can, at times, make or break the system. When attachments are added to the vessel, those too should be optimized to address resistance concerns.

Last May, Naval Surface Warfare Center Carderock Division engineer Dr. David Coakley of the Maritime Systems Hydromechanics Branch tackled that issue head on and was awarded a patent for a "Chevron Ribbon Fairing Apparatus" (U.S. 10,286,983) a device purposed to reduce hydrodynamic drag on marine cables that are used to tow items underwater. While the Navy does not have a relatively large amount of towed systems, the ones in use are often carrying out significant tasks such as mine hunting that Coakley believed could benefit from an improvement on the cable fairings.

Coakley's research didn't begin at the chevron ribbon fairing idea. In 2014, he and others were given funds to explore the general concept of drag reduction using fairings. Within a year, the group built a mechanism that allowed them to test fairings at multiple angles based on the various speeds and flows.

"After the first battery of tests, we realized the existing fairings probably had some shortcomings when towed at an angle to the

flow," Coakley said. "That's what made me think of the chevron fairing."

To test the idea, Coakley took cable samples to Carderock's 36-inch water tunnel and measured the vibration produced from the water running over the cables. About 40 samples were tested and from those, Coakley was able to determine three to take to the 12-inch water tunnel for further evaluation. The vibrations group at NSWC Philadelphia assisted Coakley with finding the most effective way to measure the cables' response to water speeds between 0-20 knots.

*Dr. David Coakley,
engineer,
Maritime Systems
Hydromechanics Branch.*

The chevron ribbon fairing, according to the patent, is designed to accommodate tow angles between 10 and 90 degrees. If the vertex angle of this fairing is double that of the cable's towing angle to the flow, the chevron concept can operate at its highest efficiency. A variety of pliable materials can be used to make the fairings, which are woven through the cables at the chevron's vertex so its legs are free to move and align with the flow of movement.

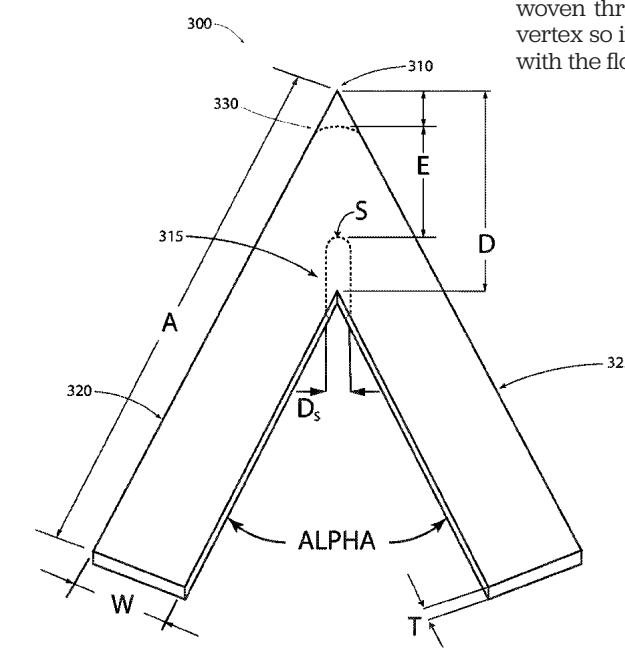


Figure shows the geometry and principle dimensions of the preferred embodiment of the chevron ribbon fairing. (U.S. Patent 10,296,983 Fig. 3)



By itself, though, the chevron ribbon fairing was not as effective as Coakley hoped it would be. "In a couple cases it turned out to be a little bit better, but in other cases a little bit worse than existing fairings," he said. What he did discover was that combining the chevron concept with a second type of fairing - a Sandwich Ribbon Fairing - would yield more favorable results for reducing hydrodynamic drag.

"Around the same time, I put in a patent application for the Sandwich Ribbon Fairing," said Coakley of the second fairing, which is still in pending status. "What this does is come up with a simple means by which one can have a ribbon fairing with a variable stiffness and increased stiffness. If the fairing stiffness is increased the right amount, then you can eliminate the flapping and waving in the flow at realistic speeds."

Coakley also said that funding for fairing improvements have since ceased as the Navy determines if such will be necessary at a large scale. Should the decision be made to go forward, he is confident that a combination of enhancements including those he investigated can provide positive outcomes for the systems that would benefit.

"It's always going to be a niche for the Navy because we don't have that many towed systems," Coakley said. "In cases where fairings are used, it turns out they're very important. They can make or break a system."



Gregory Nehl, a welding engineer evaluates a robotic weld in the NSWCDD Welding Automation Lab (U.S. Navy video still by Nicholas Brezzell/Released)

ENGINEERS WEEK FEATURES NSWC CRANE TD AND COAST GUARD LEADERS

By Edwin Hernandez and Brooke Marquardt, NSWC Carderock Division Public Affairs



Engineers Week guest speaker Capt. Kristi M. Luttrell, Commander, Coast Guard Sector New Orleans, discusses her topic "A volcano of oil at the bottom of the Gulf," with Naval Surface Warfare Center, Carderock Division employees on Feb. 11, 2020.
(U.S. Navy photo by Edwin Hernandez)

Naval Surface Warfare Center, Carderock Division's annual Engineers Week started Feb. 11 with a presentation from the Commander of Coast Guard Sector New Orleans Commander Capt. Kristi Luttrell and Chief of Emergency Contracts Operation Branch at the Coast Guard Shore Infrastructure Logistics Jackie Dickinson from Norfolk, Virginia. Together, these women presented on the topic, "A Volcano of Oil at the Bottom of the Gulf."

In 2004, Hurricane Ivan moved through the south coast and toppled one of the oil platforms in the Gulf of Mexico. For 15 years after the storm, a sheen of oil was visible on top of the water until April 2019 when a containment system was installed and designed by an emergency contractor under the direction of the Coast Guard.

Luttrell and Dickinson spoke at length on how the containment system worked, how the contractor was selected and the leadership challenges involved in implementing this groundbreaking effort to contain the oil spill.

"We spent a year trying to get our game plan together for how we were going to respond to this. In the Coast Guard, we don't usually do responses like this on this big of scale, that cost this much money, but this was a targeted, measured risk we needed to take," Luttrell said.

A week later, on Feb. 19, Carderock welcomed NSWC Crane Division Technical Director Brett Seidle as a guest speaker. Seidle discussed "The Impact of Leadership on Culture: The Paul O'Neil/Alcoa Story" with Carderock employees on Feb. 19, sharing his experiences with former Alcoa CEO and Chairman, Paul O'Neill.

In the late 1980s and 1990s, factory jobs in aluminum industries offered less than adequate safety conditions for their employees. At the age of 18, Seidle experienced firsthand dangerous working conditions for General Motors and suffered third degree burns after equipment malfunction.

"I was working in the foundry industry for General Motors at the time, and I was running a co-op machine which injected molten

aluminum at 1,300 degrees Fahrenheit with 3,000 psi to make a casting," Seidle said. "One day the machine did not close all the way and spat out molten aluminum, which hit me and although I had the proper PPE on, when I stripped my clothes off in the hall, I realized I had third degree burns on my neck."

Seidle was provided silver sulfadiazine (Silvadene) to treat his dermal burns and prevent infection and then expected to go back onto the factory floor to continue his normal duty.



healthy revolution in culture for the aluminum company. Seidle recalled watching his co-workers buy into O'Neil's values, which also coincidentally transcended a popular economic boom for the Alcoa Company.

Prior to O'Neil's implemented change, Alcoa was infamously known for having a 40% chance of being injured on the job, Seidle said. The new safety culture developed a powerful relationship between factory employees and leadership personnel.

Seidle recognized the effects of this change and mentioned to Carderock employees that he models his leadership after O'Neil. He highlighted values as an agent of change that can influence an individual's working environment. Seidle emphasized leaders must express their values clearly, be intentional in their behaviors and recommended everyone remain true to themselves.

Naval Surface Warfare Center (NSWC), Crane Division Technical Director Dr. Brett Seidle quizzes NSWC Carderock employees on leadership qualities during his Engineers Week presentation on Feb. 19, 2020.

(U.S. Navy photo by Harry Friedman)

"My boss at the time asked me if I knew what I did wrong, and I told him 'yes, I closed up on overflow' and he said, 'OK, don't do it again' and wanted me to get back to work 30 minutes after the incident," Seidle said. "They treated molten aluminum like it was water."

In 1995, Seidle accepted a position with a joint venture between Alcoa and Cast Metals Industries, becoming the plant manager of the CMI-Precision Mold casting facility in northern Indiana. It was at Alcoa where Seidle met O'Neil and witnessed positive change in safety protocol at the workplace.

O'Neil announced there would be zero injuries in his first speech as CEO of Alcoa and outlined his commitment to workers safety. His intention was well received amongst factory workers and sparked a

"I tell people all the time, if you find that you're incongruent between your work-self and your personal-self, you ought to pause and reflect," he said. "The things you decide to be about, you need to be about. You need to be who you are."

Other qualities important to leadership, according to Seidle, included unity, authenticity and service.

"When we do things for others, it makes us happy," he said. "Looking after their well-being and considering their needs should not be underestimated. I'm here to tell you that if you do those four things, if you model yourself on values based behavior; if you're authentic and comfortable in your own skin; serve others well; and care enough to share, you will impact your culture wherever you are at."

TECHNICAL DIRECTOR'S CUP GOOSE BUSTERS REPRESENT CARDEROCK

By Edwin Hernandez, NSWC Carderock Division Public Affairs



Since March, the United States has been combatting a modern pandemic that has forced major organizations, like Naval Surface Warfare Center (NSWC), Carderock Division, to alter their work habits. Although the global health crisis has canceled many events around the world, the Technical Director's (TD) Cup proceeded in a new, virtual format.

The TD Cup, which is a cross-Warfare Centers competition, aims to enhance workforce development for employees with less than five years of work experience in machine learning and artificial intelligence (AI). While the competition has been held in Panama City, Florida, since its inception in 2017, this year's TD Cup was moved to local venues for each participating team in light of global health concerns.

Team Goose Busters represented Carderock at this year's competition and featured employees from multiple departments across the command. Engineers Stephanie Blease, Alexandra Lechner, Isaac Downey

and Mei Ling McAfee were selected to represent Carderock's team, and were joined by their team mentor Benjamin Gordon. During Sept. 14-18, team Goose Busters performed trial runs of their unmanned ground vehicle (UGV) at Carderock's Olney Support Center in Olney, Maryland.

The objective for this year's TD Cup was to clear an amphibious landing path of Improvised Explosive Devices (IEDs) for Marines. Each team was responsible for modifying a base UGV platform and was tasked to utilize and customize software and hardware to accomplish the given mission. The IEDs, which were represented by backpacks with protruding wires, needed to be disarmed and the distractors, represented by cardboard boxes, moved a certain distance away from the assault lane.

"Our goal was to put together a semiautonomous UGV to navigate through a complex terrain," Blease said. "In doing so, we had to implement different sensors, making sure it was able to identify targets

and non-targets. In our case, targets are boxes or book bags with wires, and non-targets can be cones or other objects."

Yet, before the team was ready to compete, there were major obstacles that needed to be addressed. One of them being the arrival of their robot.

"The lockdown affected when we received our robot," McAfee said. "Our robot comes from a company, Clearpath Jackal, that is based in Canada and understandably, the manufacturing process was delayed because of the pandemic."

In the spirit of comradery, NSWC Crane lent the team a spare robot in March that Goose Busters used until their own robot arrived at the end of July. This gesture was warmly received by the team, which kept them on schedule to deliver their experimental design.

Some of the unique ideas the team added to their robot included a five-axis robotic arm with wire-cutting capability; a small raspberry pi camera; a stereo camera; and a LIDAR system. Each piece of equipment played a critical role in the team's navigation, classification and neutralization challenges.

Although the team only had a little over a month to incorporate their additions onto their robot before September's competition, they undoubtedly managed to create an optimal machine.

"We tried to improve different components," Downey said. "We placed a light bar on our robot to indicate what state the robot is running in: autonomous, manual or idle.

Team Goose Busters' robot clips a mock IED in preparation for the competition at Naval Surface Warfare Center, Carderock Division's Olney Support Center in Olney, Md., on Sept. 17, 2020. (U.S. Navy photo by Eric Silberg)



There was a lot of fabrication work and cable work that was done, as well as CAD (computer-assisted design) modelling to determine the best place to put our sensors."

One of the most difficult challenges the team faced was the departure of their teammate Alexandra Lechner.

"We started out as a team of four, but one of our team members left government employment for another job opportunity around the beginning of August," Gordon said. "After her departure, the rest of the team had to pick up the pieces of the project she had been working on, which was mainly the object recognition and classification side of things."

On Sept. 17, Goose Busters performed their competition run at Carderock's Olney Support Center with Carderock's Technical Director Larry Tarasek, who has been a key supporter throughout the year, in attendance.

Huddled together by a tent, Downey, McAfee and Blease operated their robot by using computer monitors and Bluetooth to communicate with it, and manually controlled their device by using a PlayStation 4 controller. With these functions in place, they were able to adjust speed levels and guide their robot through the hay-baled obstacle course.

Three judges assessed the team and their robot as it attempted to complete the mission. Each judge was assigned to evaluate a certain part of the trial run, which included obstacles hit, targets neutralized, manual

control and time elapsed. Of the 15 targets - 13 of which were eligible for neutralization - the team managed to identify nine, neutralizing seven of them in the process.

Gordon, who managed all administrative components for the team with Marine Corps Vulnerability and Project Lead Rodney Peterson, said he appreciated the hard work of NSWC Panama City, who outlined obstacle course specifications and the scoring rubric for the competition. While Gordon handled the team's expenditures, communication with other WCs and scheduling, he also served as technical support for the team.

"Although I wasn't allowed to do any actual work myself, if the team had conceptual questions or needed some ideas on what direction they should be going, I was able to provide that guidance," he said. "Since the competition was moved locally, I was responsible for setting up the course and organizing the judging. It was quite a unique experience, especially buying 200 bales of hay, but the experience was invaluable because I got to see the project from an organizational point of view rather than a technical one."

The 2020 TD Cup was Carderock's first involvement in the competition, and Tarasek is keen to continue participating at the event.

"I thought it was a great opportunity to create a team of Carderock engineers from across the command that could put together an unmanned capability and compete against

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From left: Engineers Stephanie Blease, Mei Ling McAfee and Isaac Downey stand with their Team Mentor Benjamin Gordon, Marine Corps Vulnerability and Protection Manager Rodney Peterson and Technical Director Larry Tarasek before competing in the TD Cup on Sept. 17, 2020. (U.S. Navy Photo by Devin Pisner)

some sister Warfare Center Divisions," Tarasek said.

With the help of senior leadership, Tarasek was able to provide the command an opportunity for young engineers to meet other employees outside their branch and gain some exposure to project management.

"Working with Rod Peterson and Steve Ouimette, we put a really good team together," he said. "We have folks from across the command who, in some respects, have not worked together before, and now they are. This is the way we are going to innovate and collaborate in the future."

While planning for next year's competition has already begun, Goose Busters have set the standards for future Carderock teams. As Carderock's TD said, "COVID hit, and it didn't slow them down, kudos to all of their hard work."

CARDEROCK MEMBERS RECEIVE EXPERIENCE OF A LIFETIME

By Todd A. Hurley, NSWC Carderock Division Public Affairs

Two Naval Surface Warfare Center, Carderock Division employees recently participated in the experience of a lifetime. Brian Mills, naval architect and test engineer, and Thomas Bruno, electrical engineer, both from Carderock's Dynamic Measurements and Testing Branch of the Survivability and Weapons Effects Division, were Pacific Fleet (PACFLT) representatives for Exercise Valiant Shield, one of the largest U.S. military war games held in the Pacific Ocean.



Exercise Valiant Shield focuses on the cooperation between military branches, as well as the detection, tracking and engagement of military units at sea, on land and in the air.

"Valiant Shield is the perfect opportunity for the U.S. military to come together in a high-end training, joint environment to ensure the United States military maintains our competitive advantage," Rear Adm. James Aiken said, Valiant Shield 20 Director, U.S. Navy.

The 12-day exercise, which ran from Sep. 14-25, saw more than 11,000 Soldiers, Marines, Sailors and Airmen come together to train in a real-world environment to demonstrate their military readiness.

Bruno, Mills and a few other individuals initially volunteered to be part of a different exercise back in February, but plans stalled due to the Coronavirus. When PACFLT came back later and asked for help with Exercise Valiant Shield, Bruno and Mills leapt at the opportunity, despite the rigid restriction of movement (ROM) requirements.

The two flew to Japan where they underwent an 18-day quarantine at Naval Station Yokosuka, bound to a single barracks room together.

"We were friends before, but sharing a room for that long definitely bonded us," Bruno said.

Electrical engineer Thomas Bruno (left) and naval architect and test engineer Brian Mills, both from Naval Surface Warfare Center, Carderock Division, stand together prior to their release from quarantine at Naval Station Yokosuka, Japan, on Sept. 11, 2020.
(Photo provided)

Once their quarantine was complete, the two were transported directly to the USS Antietam (CG 54), where they served as data collectors.

"We were there to take notes and make observations - to capture what was going on in the room," Bruno said. "PACFLT can see the different decisions the ships made, we were there to provide the why."

Mills went on to add that, "We weren't assessors; we were there to observe the actions. After each event we would type up our notes and submit them to PACFLT."

The two did not, however, get to experience Exercise Valiant Shield together. Mills served aboard USS Antietam (CG 54), a Ticonderoga-class guided missile cruiser, and Mills served aboard USS Barry (DDG 52), an Arleigh Burke-class guided missile destroyer.

"Typically there are a team of observers on each ship, and some ships had two or more observers (USS Ronald Reagan and USS Shiloh). Thomas and I were the only solo observers on separate ships," Mills said. "We had no experience, so we had to learn on the fly."

While the war game exercises took up the majority of their time, the two of them were still able to get a glimpse into the everyday life of being a Navy Sailor.

"We got to witness two or three live-fire events," Bruno said. "That was incredible. Aside from that, I really enjoyed meeting the Sailors and listening to their stories. It was interesting to learn what it's like to be a Sailor during COVID-19 - they are stuck on the ships, they can't really go anywhere.

Even when the ship is in port, they are never allowed farther than the pier."

Mills, on the other hand, was already well aware of what it was like to be a Navy Sailor.

"I joined the Navy a few years after High School," Mills said. "I qualified for the Navy Nuclear Power Program, which seemed like a cool opportunity, so I did that and went to work on submarines, because I wanted to learn more about them."

Mills was on active duty for six years and served aboard USS Connecticut (SSN 22), a Seawolf-class nuclear powered fast attack submarine.

"Overall, it was a great experience, and I learned a lot," Bruno said. "It was interesting

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to be in the ship's command center and to see what modern naval warfare is all about. It was very rewarding to see how the work we do in our daily jobs affects the fleet and their effectiveness."

For Mills, his favorite part about not only participating in Exercise Valiant Shield, but also working at Carderock is "the feeling of still being part of the Navy team and being able to provide a service," he said.



USS Antietam (CG 54) and the USS Tippecanoe (AO 21) perform a replenishment at sea (RAS) on Sept. 13, 2020, during Exercise Valiant Shield in the Pacific Ocean.

(U.S. Navy photo by Thomas Bruno)



Capt. Todd Hutchison (right) stands with Capt. Cedric McNeal after taking command of Naval Surface Warfare Center, Carderock Division in a ceremony in West Bethesda, Md., on July 10, 2020. (U.S. Navy photo by Nicholas Brezzell)

CARDEROCK DIVISION CHANGES COMMAND

By Kelley Stirling, NSWC Carderock Division Public Affairs

Capt. Todd E. Hutchison relieved Capt. Cedric J. McNeal as commanding officer of Naval Surface Warfare Center (NSWC), Carderock Division in a ceremony July 10, 2020, in West Bethesda, Maryland.

McNeal, who was the 38th commanding officer at Carderock, thanked as many people as he could during the ceremony, focusing on the contributions and talents of each department.

During his time at Carderock, McNeal saw his fair share of both successes and challenges. He commended the people of Carderock for their steadfastness in support of the mission.

“Carderock has the ability to navigate - as demonstrated during this time - through whatever challenges that may be presented and still continue to excel, deliver and be known for the pillar of ship and submarine design,” McNeal said.

Capt. Michael Richman, chief of staff for Naval Surface and Undersea Warfare Centers, presented the Legion of Merit Medal to McNeal for his performance as the commanding officer of Carderock Division.

“Capt. McNeal ensured NSWC Carderock’s world-class facilities supported continued delivery of capability, with improved material condition of testing infrastructure, across its various acoustic measurement sites,” according to the award citation. “His leadership was crucial in finalizing the acquisition of the Olney Federal Support Center, enabling NSWC Carderock to accept more tasking to address emerging threats in developing ship and submarine

training systems, acoustic, electromagnetic and topside signature solutions, and next generation platform designs.”

Richman then presented McNeal with a plaque, thanking him on behalf of Rear Adm. Kevin Byrne, commander of Naval Surface and Undersea Warfare Centers.

“It’s important in this day of great power competition that all the divisions are giving 100% to the mission,” Richman said. “Certainly, Carderock is doing that; and that’s a testament to, not just the workforce at Carderock, but also to your leadership.”

McNeal’s next assignment was to Naval Sea Systems Command (NAVSEA) as the Amphibious Warfare Program Manager (PMS 377). He had been in a program office before coming to Carderock, and he said, in a sense, he “grew up” there. However, he said that having been the commanding officer of a Warfare Center gave him a renewed perspective going back into program management.

“I have much more appreciation for the Warfare Centers and what they bring in the way of talent, technical expertise and support for the enterprise,” McNeal said.

In closing, McNeal again thanked all the Carderock employees for making his experience something he will always remember.

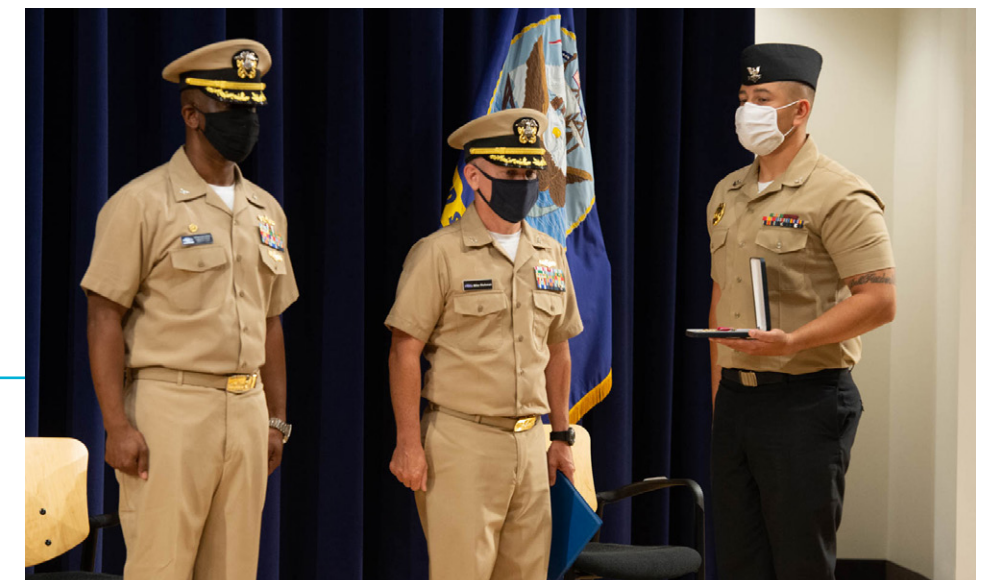
“With some of you - we’ve cried, prayed, laughed and argued - I guess that makes us family,” McNeal said. “But, most importantly each of you have inspired me to be better, and while your military leadership changes today, your push to continue to be the best should never change.”

Hutchison came to Carderock from NAVSEA, serving as a deputy assistant program manager in the Guided-Missile Frigate (FFG(X)) Program Office (PMS 515), where he worked with McNeal. Earlier in his career, he was the commanding officer of USS Michael Murphy (DDG 112), the culmination of his career as a surface warfare officer.

When taking command, Hutchison thanked the people in his life and said he was honored to become the 39th commanding officer of Carderock.

“From its start over 120 years ago at the Experimental Model Basin at the Navy Yard, with Adm. David Taylor as its first commanding officer, to its move to this location just before World War II, and over the years to the expansions to sites all over the country, the one constant has been the unprecedented contributions the women and men of Carderock have made to our Navy and our country,” Hutchison said. “I am thrilled to become a member of this team, and excited to see what the next several years will bring.”

A Sailor holds the Legion of Merit Award that Capt. Michael Richman (center), chief of staff for Naval Surface and Undersea Warfare Centers, presented to Capt. Cedric McNeal for his successful time as commanding officer of Carderock Division on July 10, 2020. (U.S. Navy photo by Nicholas Brezzell)



EEO OBSERVANCE

CARDEROCK HONORS BLACK HISTORY WITH RETIRED ARMY COLONEL

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

In keeping up with this year's celebration of Black History Month, Naval Surface Warfare Center, Carderock Division hosted retired Army Col. Gregory Gadson on Feb. 24, 2020, to honor achievements and contributions of Black Americans to the United States Armed Forces.

A graduate of the United States Military Academy at West Point, Gadson spent 25 years as an Army officer until he retired in 2014. His massive list of accomplishments in and out of uniform range from commanding troops in every major conflict of the last two decades to playing a role in the 2012 film Battleship. Both of his parents were born and raised in the segregated south and graduated from Howard University in Washington, D.C., instilling in him early in life the importance of perseverance during adversity.

"Experiencing the severities of a society that was not just to them under the rules of the Jim Crow South, I'm truly proud of how they raised me, in that they didn't pass the hate and the negative parts," he said. "They shared the challenges, of course, but they didn't impart the hatred upon me."

Retired Army Col. Gregory Gadson visited Naval Surface Warfare Center, Carderock Division for the command's Black History Month Observance on Feb. 24, 2020, where he shared stories of the struggles and successes he endured after an attack during a deployment cost him his legs.

(U.S. Navy photo by Harry Friedman)



Like many others before him, Gadson chose to serve the country through uniformed service. Searching for the opportunity to play Division I football led him to West Point, beginning his Army career. At one point in time, he was interested in attending the United States Naval Academy, who also had interest in recruiting him for his athletic ability. Thoughts of withdrawing his commitment from West Point were dispelled by his father's advice to honor his original agreement, thus beginning his Army career.

During his 17th year on active duty, however, Gadson's life was changed and he had to lean on the teachings of his parents as he was forced to turn tragedy into triumph.

When President George W. Bush announced the surge of forces to Baghdad, Iraq, in the mid-2000s, Gadson's battalion was one of

the six between two brigades to be called to the overseas mission. They deployed in February of 2007 and within months, Gadson was traveling from a memorial service for two Soldiers in his brigade who had lost their lives in the fight when the unthinkable happened. An improvised explosive device detonated, lifting his vehicle off the ground and ejecting him over 100 meters from the stopping point of the vehicle.

"As I laid down on the ground, I knew something was wrong with me, and I knew it was serious," Gadson said. "I couldn't move. My last thoughts before I lost consciousness was 'God, I don't want to die in this country.' And then I was out."

He survived the explosion, but needed over 100 units of blood and went into cardiac arrest six times within the first six hours of

the attack. Four days after he was wounded, Gadson was transferred to Walter Reed National Military Medical Center. The next few weeks were filled with surgery after surgery, ultimately resulting in the amputation of both of his legs above the knees and losing some functionality in his right arm. At times, Gadson could not see a positive outcome to his situation and felt like giving up, but remembering his duty to his family at home and his soldiers still deployed helped him find a renewed sense of purpose.

That fall, Gadson was given the opportunity to speak to the New York Giants football team through a former West Point teammate, becoming an inspirational leader for a team who battled their own adversity after starting the season 0-2 to win Super Bowl 42 by the end of the season.

Four years later, he took command at Fort Belvoir to become the first double amputee garrison commander of a major installation in the Army. By the time of his retirement in 2014, Gadson's name and accomplishments were well known across the military and into the civilian world, but at one point he wasn't even sure if he'd make it out of Afghanistan.

"In the month of May 2007 alone, 131 United States service members paid the full measure, but I am here today because my team saved my life," he said.

His team, like the rest of the military, consisted of people from all walks of life. Leading a diverse group requires the ability to relate to many cultures, a quality that Gadson said comes with understanding the history of different groups of people. Rather than allowing difference to separate, he said he has committed himself to learning about the past of others, stressing the point that Black history is American history and that American history connects everyone.

"That's why we do observances like this, so that we can live up to the best that we can be and form a more perfect union," Gadson said. "That is our strength, and that is our challenge."



Inset: Retired Army Col. Gregory Gadson exchanges words with Naval Surface Warfare Center, Carderock Division's Dr. Maureen Foley as Commanding Officer Capt. Cedric McNeal looks on following Carderock's Black History Month Observance on Feb. 24, 2020.

(U.S. Navy photo by Harry Friedman)

EEO OBSERVANCE

MADALENA FEATURED FOR DISABILITY EMPLOYMENT AWARENESS MONTH EVENT

By Kelley Stirling, NSWC Carderock Division Public Affairs

Naval Surface Warfare Center (NSWC), Carderock Division hosted the National Disability Employment Awareness Month (NDEAM) event on Oct. 22 featuring Carderock deaf employee Tony Madalena, director of operations for the Center of Innovation in Ship Design (CISD).

The theme this year for NDEAM was “Honoring the Past, Securing the Future,” commemorating the 75th Anniversary of World War II.

“By remembering the past, we can secure the future and ensure we can meet the goal

of providing a more inclusive workforce that fosters an environment where all people are recognized for their abilities and valued for their contributions,” said Capt. Todd E. Hutchison, Carderock’s commanding officer. “Let us be inclusive of everyone, no matter how they are different from us. Having a diverse perspective will always make us stronger as an organization. Remember, we are one Carderock.”

While this event highlighted the accommodation needs of the deaf and hard-of-hearing community, as well as

the services available, Larry Tarasek, Carderock’s technical director emphasized the needs of disabled employees as a whole.

“This month is about recognizing that people with disabilities are able to be part of the workforce and offer significant contributions to our mission and working for the warfighter,” Tarasek said.

Madalena worked at NSWC Dahlgren for nine years before transferring to Carderock in December 2017. In his role at CISD, he oversees daily operations and the budget. He also mentors and trains junior engineers

Jet Griffin (left), one of three sign-language interpreters at Naval Surface Warfare Center, Carderock Division, and Tony Madalena, director of operations for the Center of Innovation in Ship Design at Carderock, answer questions during the National Disability Employment Awareness Month event on Oct. 22, 2020. (U.S. Navy photo by Neubar Kamalian)

during their journeyman projects as team leads, confirming they are producing successful projects on time that show significant innovation studies.

Having a higher-level position means Madalena requires a sign-language interpreter most days. Carderock has three full-time American Sign Language (ASL) interpreters, who support 10 deaf or hard of hearing employees currently.

Rebekah Knodel, the lead sign-language interpreter at Carderock, spoke about the necessity of their role at Carderock. The other interpreters are Paris McTizic and Jet Griffin.

“We wouldn’t be able to have such a robust staff of highly qualified interpreters if it weren’t for buy-in from our senior leadership,” Knodel said. “This high level of



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support helps us best work with our deaf and hard of hearing team members.”

Knodel talked about ASL as a living and constantly evolving language, especially in a technical environment such as Carderock. She said not everything has a sign in ASL and gave COVID-19 as an example. The deaf community came up with a sign for coronavirus, which spread across social media and quickly became universally known.

“On a smaller scale, during meetings here on base, we often have to come up with signs in the moment,” Knodel said. “There are no signs for things like fleet, or AMPHIB, or obligation, or lathe. So, those are things we’ve come up with with our deaf and hard of hearing coworkers, sometimes right in the moment of a meeting.”

Tony Madalena, director of operations for the Center of Innovation in Ship Design at Carderock, speaks about his experience as a deaf person during the National Disability Employment Awareness Month event on Oct. 22, 2020. (Image is a screen grab of the livestream event)

Madalena told his unique story about his experiences as a deaf person with the hope of raising awareness about deafness and about the deaf community as a whole.

Growing up in Rochester, New York, Madalena was exposed to a robust deaf community, attending the Rochester School for the Deaf and then Rochester Institute of Technology, where he earned his degree in mechanical engineering.

He immediately started working at NSWC Dahlgren Division. He was hired via the Workforce Recruitment Program, which

provides opportunities for students with disabilities to pursue internships and employment with the federal government across the nation.

At Dahlgren, he was the initially the only deaf employee that required accommodations of a sign-language interpreter. He spoke with his leadership, and they hired a full-time sign-language interpreter. When he transferred to Carderock, there were more deaf or hard of hearing employees, but the organization was using a contract for as-needed support of ASL interpretation. Madalena said the vendor would often send interpreters who were not qualified and couldn’t keep up with the complexities of the work. He again approached his leadership about the problem, and Carderock hired one full-time sign language interpreter, which was Knodel. He said the need for her services skyrocketed, and that’s how Carderock ended up with three.

“Think of all the work we do from engineering to science to finance, it’s all incredibly complex,” Madalena said. “I’m so grateful that the leadership at both Carderock and Dahlgren took the time to listen to what I needed and provided the caliber of interpreters required for the technical work that we do.”

Madalena lives in Frederick, Maryland, which he said is similar to Rochester in that it has a robust deaf community because of Maryland School for the Deaf. He raised his children, who can both hear, to be bilingual in English and American Sign Language. He said they learned to sign before they could speak.

For anyone wanting to learn sign language, Knodel had a couple of recommendations: The first is the ASL App, which was created by deaf people and specifically aimed at beginners for learning basic signs. Another resource is ASL Connect from Gallaudet University. Lastly, deaf and hard of hearing co-workers are a good resource for learning ASL. However, Knodel strongly suggested not using YouTube to learn sign language.

NATIONAL DISABILITY AWARENESS MONTH OBSERVANCE



Background

- Born and raised in Rochester, NY
 - One of the largest Deaf communities
 - Currently resides in Frederick, MD
 - Another well known Deaf community
- Mechanical Engineering degree from RIT
- 9 years at NSWC Dahlgren
- ~3 years at NSWC Carderock
 - Currently CISD Director of Operations

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EEO OBSERVANCE

MAJOR GEN. YEAGER SPEAKS AT WOMEN'S HISTORY MONTH EVENT

By Brooke Marquardt, NSWC Carderock Division Public Affairs

Every year, the United States celebrates National Women's History Month, a celebration that was not made official until 1981 when Utah Senator Orrin Hatch and Maryland Representative Barbara Mikulski co-sponsored a Congressional resolution. Originally, it was only a Women's History Week and was created to include March 8, International Women's Day. It expanded to be the entire month in 1987.

Naval Surface Warfare Center, Carderock Division celebrated Women's History Month on March 3. Yeager is the first female active duty or National Guard general officer to lead a combat infantry division.

"I'm proof that diversity is working in our armed forces. It's not just words in my organization. I have been mentored and supported for many years, and it is the reason I am in the position I am today," Yeager said.

She is a two-star general who flew combat operations with the California National Guard in 2011, led California's 40th Combat Aviation Brigade and became the top officer on June 29, 2019. Yeager has served since 1995 and earned her first star in 2016. Earning this star made her only the fourth female general officer in California National Guard history to do so.

In 2013, the Secretary of Defense lifted the restrictions on women serving in combat roles.

"This is what led the way for me to be able to serve in the role the way I am now," Yeager said.

In 2015, two women graduated from Ranger School for the first time. There are now 63 women serving as either generals or admirals

across the armed forces according to figures by the Service Women's Action Network.

The new Marine Corps Commandant Lt. Gen. David Berger told Congress in April 2019 that male and female Marine Corps recruits could be training together sometime this year, ending the service's standing rules of segregating recruits into separate training units in boot camp.

"Hopefully we'll get to a point where there are no more firsts," Yeager said. "Unfortunately, somebody always has to be first, and these women lead the way for people like me. There's a saying that goes, 'You have to see it,

to be it' and now there's a whole generation who can see that they can do it."

Yeager then talked about women trailblazers, such as Marie Curie, Sally Ride, Clara Barton, Susan B. Anthony, Eleanor Roosevelt and Rosa Parks.

"The former governor of Texas, Ann Richards, once said 'Ginger Rogers did everything that Fred Astaire did, but moving backwards and in heels,' and I think that's true, but I would like to say that we are now doing everything that men do, and we're doing it in combat boots moving forward," Yeager said.



Major Gen. Laura Yeager speaks to Carderock Division employees about the importance of inspiring the next generation of women during the Women's History Month observation in West Bethesda, Md., on March 4, 2020.

(U.S. Navy photo by Edwin Hernandez)

CNO GILDAY VISITS CARDEROCK

FOCUS ON FUTURE OF MARITIME TECHNOLOGY

From Chief of Naval Operations Public Affairs



Chief of Naval Operations (CNO) Adm. Mike Gilday visited Naval Surface Warfare Center (NSWC), Carderock Division in West Bethesda, Maryland, to see the future of maritime technology on Feb. 5, 2020.

"The maritime environment in which we operate is very complex," Gilday said. "The cutting-edge work being done at Carderock will help ensure the overmatch we enjoy today will exist well into the future."

A field activity of the Naval Sea Systems Command (NAVSEA), Carderock provides full-spectrum research and development, test and evaluation, analyses, acquisition and support for the Navy's ships and their systems. NSWC Carderock Division's expertise spans from naval architecture to marine, computer, mechanical and electrical engineering.

While at Carderock, Gilday saw several Navy-wide innovation efforts, including live virtual constructive (LVC) training systems for submarine and surface ships, advanced manufacturing and corrosion control technologies, as well as current and future fleet designs, specifically for the FFG(X) and Columbia-class submarine, which is the Navy's number one acquisition priority.

"The talented workforce at Carderock is providing critical support to our warfighters each and every day," Gilday said. "They are without a doubt playing a vital role in the development of tomorrow's fleet and our future Navy."

As he toured facilities with Commanding Officer Capt. Cedric McNeal and Deputy Technical Director Steve Ouimette, Gilday was able to talk to a few Carderock employees.

HAPPENINGS AT CARDEROCK

Chief of Naval Operations Adm. Mike Gilday speaks to Naval Surface Warfare Center, Carderock Division employees with Commanding Officer Capt. Cedric McNeal and Deputy Technical Director Steve Ouimette in West Bethesda, Md., during his visit on Feb. 4, 2020.

(U.S. Navy photo by Devin Pisner/Released)

"It's good to see people so passionate about the work. More than 170 Ph.D.s in this competitive environment is really impressive," Gilday said. "Every aspect of what you do connects directly to the warfighter. Remember - you are making a difference every day. What you are working on is critically important, and my hat's off to you."

NEW NSWC/NUWC COMMANDER VISITS CARDEROCK



Capt. Cedric McNeal (above left), commanding officer of Naval Surface Warfare Center, Carderock Division gives Rear Adm. Kevin Byrne a tour of Carderock's facilities on June 4, 2020. Byrne was at Carderock for his first tour of the West Bethesda, Md., site since becoming commander of the Naval Surface and Undersea Warfare Centers.
(U.S. Navy photo by Nicholas Brezzell)

James (Jake) Shilling (right) talks to Rear Adm. Kevin Byrne on June 4, 2020, about the capabilities in Naval Surface Warfare Center, Carderock Division's Deep Submergence Test Facility, which houses pressure tanks of varying capacities and pressure ratings to simulate deep ocean environments for structural test and evaluation. Byrne was at Carderock for his first tour of the West Bethesda, Md., site since becoming commander of the Naval Surface and Undersea Warfare Centers.

(U.S. Navy photo by Nicholas Brezzell)



SECNAV & ALASKA SENATOR TOUR SEAFAC

HAPPENINGS
AT CARDEROCK

Jenny Kelso (fourth from right), site director for Naval Surface Warfare Center, Carderock Division's Southeast Alaska Acoustic Measurement Facility, provides a tour of the Ketchikan, Alaska, site on Aug. 31, 2020, to Secretary of the Navy Kenneth Braithwaite (left of Kelso), U.S. Senator Dan Sullivan (third from left), and members of the Alaska state legislature. The Alaskan Senator invited Braithwaite on a tour of Alaska, and Ketchikan was the first stop. Kelso provided a tour of the Back Bay Shore Facility and briefed them about Carderock's history of full-scale acoustic testing and the unique acoustic environment in Western Behm Canal that allows them to make critical measurements for the fleet. The SEAFAC Static Site in Behm Canal is in the background.

(Photo provided)



PEO SUBS VISITS ACOUSTIC RESEARCH DETACHMENT

Rear Adm. David Goggins, Head of the Program Executive Office for Submarines, visited Naval Surface Warfare Center, Carderock Division's Acoustic Research Detachment in Bayview, Idaho, on Jan. 27. While there, Goggins toured ARD's large-scale models, facilities and measurement capabilities with a focus on how these facilities and models support important Navy acoustic signature technology initiatives and programs. Carderock Signatures Department Head Dr. Paul Shang briefed Goggins on the overall mission of the Carderock Signatures Department and ARD Director Alan Griffiths gave him an overview how ARD is supporting present and future submarine programs. Pictured from left to right: Tom Pfeifer (Carderock), Pat Tayler (Carderock), Kelly Veillette (Carderock), Shang (Carderock), Brian Quarles (PEOSUB), Goggins (PEOSUB), John Vlattas (PEOSUB), John Becker (Carderock), Marylou McNamara (Carderock) and Griffiths (Carderock).

(U.S. Navy photo by Jim Klein)



ALBERT EINSTEIN FELLOW BEGINS WORK WITH CARDEROCK

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Addressing the ever-changing landscape of the science, technology, engineering and math (STEM) arena is a task that requires dedicated efforts from its professionals. For the second consecutive year, Naval Surface Warfare Center, Carderock Division, is partaking in the Albert Einstein Distinguished Educator Fellowship (AEF) Program, a Department of Energy initiative that gives K-12 STEM teachers the opportunity to work with various government agencies for one year.

Leadership at Carderock said that the key to the future of the field lies in the education of the next generation of STEM professionals. The command is hosting three teachers for this year's cohort: Laura Larkin of San Carlos, California; Michael Vargas of Phoenix, Arizona; and Suzy Otto of Paris, Missouri. Otto is detailed specifically at Carderock, while Larkin is assigned to the Department of Defense STEM Office, and Vargas with the DOD Manufacturing Technology Office Program. This unique experience gives the teachers a chance to create a larger-scaled impact in the field.

"A lot of these teachers that have been chosen for the fellowship have stellar leadership skills behind them," said Charlotte George, Carderock's STEM and Outreach Program Director. "This gets them to put all of their energy outside of the classroom towards what some might say is the bigger picture of education."

When the command hosts events such as a robotics competition or the Carderock Math Contest, it naturally draws many local participants. However, as George pointed out, these activities are not beneficial for the students if they do not align with what they are learning in class. While STEM professionals can get passionate about their work, she said that the missing perspective from not formally trained educators can sometimes impact how productive outreach endeavors are. Teachers want their students to be interested in the field, and organizations such as Carderock want to continually bring in fresh faces, making it a must that both sides understand one another's needs. Spending the year in the AEF allows the selected teachers to address those needs at the highest levels.

"By learning more about the work done at Carderock, I'll have more first-hand, real-world knowledge to share with my students," said Otto said. "I hope to translate my experiences in an established STEM office and my interactions with teachers and students in this area to inspire new initiatives in my rural Missouri region once I return home."

Carderock's involvement with the program began from a working relationship between Tyson Tuchscherer, an alum of the program, and Toby Ratcliffe, Carderock's former STEM and Outreach Coordinator. Tuchscherer left

"I introduced Toby to the Einstein Fellowship, and she was very interested but never had the funding or the opportunity," Tuchscherer said. "The command had a period without a STEM director for a few years, then Charlotte came on, and I got her interested. This time, the opportunity, funding and interest was there. All the stars aligned to make it happen."

"He mentioned it to me when I first got the job, and helped me get all the interagency agreements set up so we could physically host fellows and participate in the program," George said. "As an educator in his first career, he saw the gap that we were struggling with and how we could translate that into making an educational impact in our community."

The 2019 academic year marked Carderock's inaugural participation in the Fellowship. Assigned to the command was Debbie Reynolds, the STEM Coordinator for the Baldwin-Whitehall School District in Pennsylvania prior to her fellowship. Reynolds has been an educator for nearly 30 years, and has always emphasized the importance of access and awareness for uncommon STEM opportunities. On her first day as a fellow, she was blown away at the work that was taking place at Carderock, and most notably, who was doing it.

"Even though I had family in the Navy, I wasn't aware of how many people are civilians that work for the Navy," said Reynolds, who recently became the Director of Tech Works for the Commonwealth Charter Academy in Harrisburg, Pennsylvania.

Working next to George, Reynolds got familiar with the many roles Carderock serves to the entire Navy while helping the command revamp its STEM outreach protocols. Her main goals were to ensure that the command actively promoted Naval Sea Systems Command's brand in the STEM arena, and to help the STEM and Outreach office fit their community engagements efforts into a standardized model. Although there were also fellowship-specific duties that Reynolds had in addition to working for the command, those roles seldom conflicted. When her term came to a close, Reynolds left the command with a deeper appreciation for the Navy's implementation of STEM work.

Members of this year's Albert Einstein Distinguished Educator Fellowship (AEF) Program, a Department of Energy initiative that gives K-12 STEM teachers the opportunity to work with various government agencies for one year, learn about SeaGlide on Sept. 25, 2020, in the David Taylor Model Basin at Naval Surface Warfare Center, Carderock Division in West Bethesda, Md. (U.S. Navy photo by Harry Friedman)

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provides that opportunity for us to step outside of our bubble of our school, or our district, or even statewide, and look at things from a national lens," Reynolds said. "It puts things in a little bit different perspective. When you take that back to your district, it's just a much richer experience."

2020 is expected to be the last year of Carderock hosting an AEF participant, as George predicts that future fellows who would have gone to Carderock will instead be assigned directly to the DOD STEM Office. Out of the organizations that are participating this year, Carderock is the only one that is not located in Washington, D.C. The educators have already proven to be largely beneficial to the command, but George said that they could likely affect even more change from a centrally located organization such as the DOD STEM Office.

For now, she plans to take advantage of the time the command has with this year's assigned fellows to push future STEM outreach efforts to new heights.

"I think just having two years of participation in this fellowship has totally changed our own perspective and how we can run this program and better impact STEM literacy and opportunity in this area," George said.



Charlotte George (left), STEM and Outreach Program Director at Naval Surface Warfare Center, Carderock Division; Debbie Reynolds, Carderock's Albert Einstein Distinguished Educator Fellow for 2019-20; and Eric Silberg, an aerospace engineer in Carderock's Sea-Based Aviation and Aeromechanics Branch, attend the 2020 Space Exploration Educators Conference in Houston, Texas, in February. (Photo provided)

his position as a math and science teacher in Oregon for his fellowship obligation in 2005, and opted to stay in the Washington, D.C., area when his time concluded. His post-fellowship journey led to him working on the National Defense Education Program at the Office of the Secretary of Defense, where he and Ratcliffe initially crossed paths. By 2009, Tuchscherer began to make regular appearances at Carderock and saw the potential that an AEF participant could have with the command.



CARDEROCK SIGNS EDUCATION PARTNERSHIP AGREEMENT WITH UDC

By Edwin Hernandez, NSWC Carderock Division Public Affairs

Naval Surface Warfare Center, Carderock Division and the University of the District of Columbia (UDC) signed a five-year Education Partnership Agreement on July 6 in West Bethesda, Maryland.

The agreement, which Commanding Officer Capt. Cedric McNeal and Technical Director Larry Tarasek signed with UDC President Ronald Mason, provides UDC graduate students research opportunities, internships and professional guidance in additive manufacturing, nanotechnology, material science and robotics education at Carderock.

Through this partnership, UDC students will be exposed to the command's unique facilities, equipment and research relating to surface warfare science and technology.

"This Education Partnership Agreement affords both Carderock and UDC to make headway," UDC Chief Academic Officer Lawrence Potter said. "It is clear in our work - in our deliberations through the EPA - that this fully aligns with our mission as the district's only public university. The value of UDC in terms of our graduate internships and research opportunities for students at the university will be truly enhanced by the

signing of this agreement - we very much welcome the opportunity today."

Carderock offers world-class research in the development of hydrodynamics, structures and material technology, material systems and signature and silencing systems, among more. Carderock has collaborated with several educational institutions, helping establish an encouraging environment in promoting science, technology, engineering and mathematic (STEM) careers for students.

"I cannot tell you how excited we are - as a command - to not only be able to expand



our reach, but most importantly partner with UDC in knowledge sharing and collaboration," McNeal said. "There is enormous potential here starting with not

only recruitment for hire, professor rotations and internship opportunities, but also the ability to engage with the faculty and staff at UDC. This will help us tackle some of today's top challenges and support the defense of our nation."

Tarasek spoke about the importance of staying ahead of America's competition, and highlighted additive manufacturing as a key component.

"Areas like additive manufacturing and digital sciences are critical for Carderock Division to be at the forefront of both of those areas," he said. "We look forward to partnering with UDC - not only in those areas, but in several engineering focuses."

Mason talked about his experience partnering with defense labs and the benefit he has seen in those partnerships.

"We do appreciate this opportunity," Mason said. "I see a lot of potential in it, and I guarantee that, as an institution, the

Capt. Cedric McNeal, commanding officer of Naval Surface Warfare Center, Carderock Division, and Technical Director Larry Tarasek sign an Education Partnership Agreement from their office in West Bethesda, Md., with the University of the District of Columbia during a virtual ceremony on July 6, 2020.

(U.S. Navy photo by Kelley Stirling)

Naval Surface Warfare Center, Carderock Division and the University of the District of Columbia sign a five-year Education Partnership Agreement on July 6, 2020, during a virtual ceremony. Carderock Commanding Officer Capt. Cedric McNeal and Technical Director Larry Tarasek (top left corner) signed from their office in West Bethesda, Md., and UDC President Ronald Mason (top right corner) signed from his office at the University.

(Photo by Dr. John Barkyoub)

University of the District of Columbia will put everything we can into making it work."

Dr. David Drazen, Carderock's Chief Technology Officer, will serve as the Partnership Program Manager (PPM) on behalf of Carderock.



CARDEROCK INKS PARTNERSHIP WITH MARYLAND TEDCO

By Benjamin McKnight III, NSWC Carderock Division Public Affairs

Establishing collaborative relationships with non-Department of Navy entities is a key component to the operational success of naval laboratories across the nation. September marked yet another milestone for Naval Surface Warfare Center, Carderock Division, in the realm of professional collaborations as the command entered a Partnership Intermediary Agreement (PIA)

with the Maryland Technology Development Corporation (TEDCO) on the 11th. The signing of the PIA, facilitated by the NavalX Capital Tech Bridge, took place at The Garden in Alexandria, Virginia. On hand for the ceremony was Capt. Todd Hutchison, the commanding officer of Carderock; Troy LeMaile-Stovall, the newly appointed CEO of TEDCO; and Dr. Krista Michalis, director of the Capital Tech Bridge,

in addition to other essential leaders within the command. “This agreement will foster the development of the regional technology ecosystem,” Hutchison said. “It really grows the network between industry, academia and government, as it’s related to maritime technology.” One of the stated purposes of this agreement is to identify and promote opportunities for

cooperative activities between Carderock and small business firms and educational institutions under TEDCO’s purview. The services to be provided by TEDCO are intended to establish and grow a network of industry, government, and educational partners with knowledge and expertise related to maritime innovation generally, as well as digital engineering, advanced manufacturing and unmanned systems. “I’m excited about the opportunity to look at how we can cross the Capital region to create more economic opportunities,” LeMaile-Stovall said. “As an engineer by training, to be here in this wonderful space called The Garden, I am just overly impressed both with the space and the people that we met here today, so I couldn’t be more excited to be here.”

TEDCO Chief Executive Officer Troy LeMaile-Stovall signs and places a puzzle piece on the visitor wall at The Garden Alexandria following the Partnership Intermediary Agreement signing ceremony on Sept. 11, 2020. This agreement will be a five-year partnership to promote opportunities for cooperative activities between Carderock and small business firms and educational institutions under TEDCO’s purview. (U.S. Navy photo by Benjamin McKnight III/Released)

Although the agreement is between two entities in Maryland, and The Garden is located in Virginia, regional Tech Bridges typically use off-post sites to facilitate cooperative work for accessibility purposes, making The Garden a marquee selection. Hutchison and LeMaile-Stovall were given a tour of the facilities prior to the ceremony to see all of the capabilities and features that Carderock and TEDCO will have at their disposal during this relationship. “If you ever get the opportunity to come visit The Garden, it is amazing. I’ve seen it on social media, but seeing it in person is definitely next level,” Hutchison said. When the Navy decided to form regional Tech Bridges, the intent was to enhance collaborations between naval labs, academia, industry and other military branches to accelerate the creation of solutions to the warfighters’ needs. Twelve NavalX Tech Bridges currently operate in all corners of the United States and in between, including the two Carderock is a part of: the Capital Tech Bridge which Carderock leads, and the Mid-Atlantic Tech Bridge that the command’s Combatant Craft Division in Norfolk is partnered with.

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“This agreement will foster the development of the regional technology ecosystem ... It really grows the network between industry, academia and government, as it’s related to maritime technology.”



NAVAL ENGINEERING EDUCATION CONSORTIUMS AT CARDEROCK

By Todd A. Hurley, NSWC Carderock Division Public Affairs

Naval Surface Warfare Center, Carderock Division's Naval Engineering Education Consortium (NEEC) program, a program funded under NAVSEA, was designed to "cultivate a world-class naval engineering workforce through student participation in project-based research conducted at colleges and universities."

These NEEC projects target the Navy's most prevalent technological needs: acquiring academic research to resolve technology challenges, hire college graduates with Navy research and development experience into NAVSEA and to develop exceptional working relationships with Naval engineering colleges and universities and their staff.

Every year, Carderock employees work in conjunction with different universities around the nation on Navy-related projects.

"Initially NEEC was led by the University of Michigan with NAVSEA as the primary partner," Dr. Natasha Chang said, a mechanical engineer in Carderock's Hydroacoustics and Propulsor Development Branch. "It was created to make sure there is a pipeline of students who would graduate from their universities and want to work for the Navy."

This year, there are seven Carderock-funded NEEC projects being coordinated and facilitated at universities around the nation.





University of Michigan

Dr. Natasha Chang, who has been working with the NEEC program since its creation, is part of the FY20 project at the University of Michigan. This project - the Acoustic Testing and Signal Analysis for Noisy and Complicated Environments - is led by Professor David Dowling, a professor of mechanical engineering, who has been continuously participating in NEEC projects since its 2011 creation.

"My job is to work with Professor Dowling to come up with projects that we not only care about, but ones that a team of undergraduate students can execute and be successful," Chang said.

The project itself, which is comprised of four tasks, is performed by Dowling and his students, whom he hand selects, in his laboratory at the University of Michigan.

"Professor Dowling teaches undergraduate acoustic courses, and throughout the year he advertises positions for paid year-long interns, as well as summer interns. He then interviews the candidates, finds out who is truly interested and hires the best fits," Chang said.

The process of finding the perfect fit of students can be quite difficult.

"I talk with the applicants and ask each for their resume and transcript," Dowling said. "I then start with the students who have the highest GPA. Though, admittedly, GPA is not always a direct measure of how useful the student will be on the project."

Once the students are chosen - Dowling chooses two per task (for a total of eight), with at least one of the two students on each task being a graduate student or a student with NEEC experience - he and his students then begin working on the project.

"The emphasis of the work has been on acoustic array methods that are not commonly taught, but are interesting to the Navy," Dowling said.

According to Professor Dowling, there are two common problems that the Navy runs into: the Navy has assets that, when put into the water, are used to detect adversaries, and it also has assets that move through the water on their own, which might accidentally make themselves known to the Navy's adversaries.

"This is something that should happen as infrequently as possible," Dowling said. "What we are trying to do is determine how the Navy can detect their adversaries while also being quiet enough to where they are not detected."

Dowling serves as a mentor and supervisor on the project, while his grad student provides the majority of day-to-day assistance needed by the undergraduate students.

One current project task revolves around finding simple ways to use accelerometers to quickly locate an unknown sound on a ship.

"We are generally looking at locating the source of sounds and vibrations when they are unknown, while using multiple

remote microphones, hydrophones, or accelerometers," Dowling said.

Dowling ensures that when his students are helping on his projects, the experience is vastly different than their normal course work.

"I put emphasis on learning how to do something by physically doing it - 'learn by doing'. I don't quiz them, and I don't give them homework. The students don't get a lot of experience like this from their regular coursework, which is why I try to make NEEC project work different," Dowling said.

Over the years, three of Dowling's prior students have gone on to work for the Navy.

"I find the work fascinating," Dowling said. "I like that I get to spend time with these young, energetic folks. It is very satisfying and refreshing."

Furthermore, Chang ensures that at least one student per project is rewarded for their efforts.

"At the end of each year we like to bring one student to Carderock and give them a tour of the base. The end objective is to get the students excited and interested about working with the Navy," Chang said.



Florida Atlantic University & the University of Tennessee-Knoxville

Charlotte George, NSWCCD Carderock Division's STEM and Outreach Program director, has been involved with the Naval Engineering Education Consortium (NEEC) program even before she began working here.

"I was a NEEC researcher at Florida Atlantic University (FAU) on a Carderock project the summer before I started at Carderock," George said. "As the STEM and Outreach Program Director for NSWCCD, I now manage all of the command's NEEC efforts."

Eight years after participating in student research for Carderock NEEC efforts, George is not only director of the STEM and Outreach programs, but she is making significant contributions to augment the NEEC projects.

Traditionally, Carderock's NEEC projects focus on a single student at a college or university, but Carderock is reshaping their NEEC strategy to make naval research more accessible to a broader amount of students.

"It felt like we could do more with the funding we were being given, so I decided to siphon off a very small percentage to

fund projects with experiential-learning opportunities focused on student teams tackling real-world naval problems," George said. "Beyond being a research grant, it is a pipeline for the Navy."

This not only allows Carderock to get more students involved in the projects, but also gives exposure to the Navy and Navy-relevant work to a greater amount of people.

The two newest schools to participate in Carderock's NEEC program are the University of Tennessee-Knoxville and Florida Atlantic University - George's alma mater. Both have done NEEC projects with Carderock before, but were part of the old model that focused the bulk of research efforts on only one student.

The majority of Carderock's NEEC projects have a fairly equal ratio of undergraduate students and graduate students. However, that is not the case with Florida Atlantic University.

The project title for Florida Atlantic University's NEEC efforts is the Senior Design Project in Support of Naval Applications.

"FAU's NEEC efforts will be specific to undergrads - particularly undergrads who are graduating with a bachelor's degree in ocean engineering," George said.

This will consist of three groups of seven undergraduate students working on a one-year project that deals mostly in the field of marine robotics under the direction of Dr. Pierre-Philippe Beaujean, professor of ocean and mechanical engineering at Florida Atlantic University.

"The specific topic will be chosen by the students during the first week of the semester, though it will likely deal with the topic of autonomous surface vehicles or underwater vehicles," George said. "They have the full academic year to come up with a concept and deliver a final product. This project aims to give the students an opportunity to solve a real-world problem with a physical working solution, while working as a team and communicating with stakeholders throughout the process. Part of the NEEC strategy is to help prepare students for a successful career in engineering and introduce them to career opportunities within the Department of Defense.

A Sailor applies non-skid to the cabin deckplates of an MH-60S Sea Hawk helicopter on the aircraft carrier USS Dwight D. Eisenhower (CVN 69) on Dec. 1, 2016.

(U.S. Navy photo by Petty Officer 3rd Class Nathan T. Beard)

Similarly to the project at Florida Atlantic University, the NEEC project being worked on at the University of Tennessee-Knoxville is also very much in the works, with the particulars still being put together.

"There will be two senior design teams working on naval relevant problems," George said. "Instead of marine robotics, they will be working with additive manufacturing and environmental sustainability."

The official title of the project is: A multi-scale, multi-physics solution to inform water bottle recycling at U.S. Navy makerspaces.

"Essentially, the students will be exploring fundamental science regarding repeatable filament production and extrusion of recycled materials with experimental testing," George said.

The students will be working with Dr. Stephanie TerMaath, a member of the Department of Mechanical, Aerospace, and Biomedical Engineering at the University of Tennessee-Knoxville.

The primary objective of this project is to formulate methodology for predicting the mechanical properties of chopped fiber reinforced composites fabricated with a fused filament fabrication. Also, potentially more important is the intention to inform

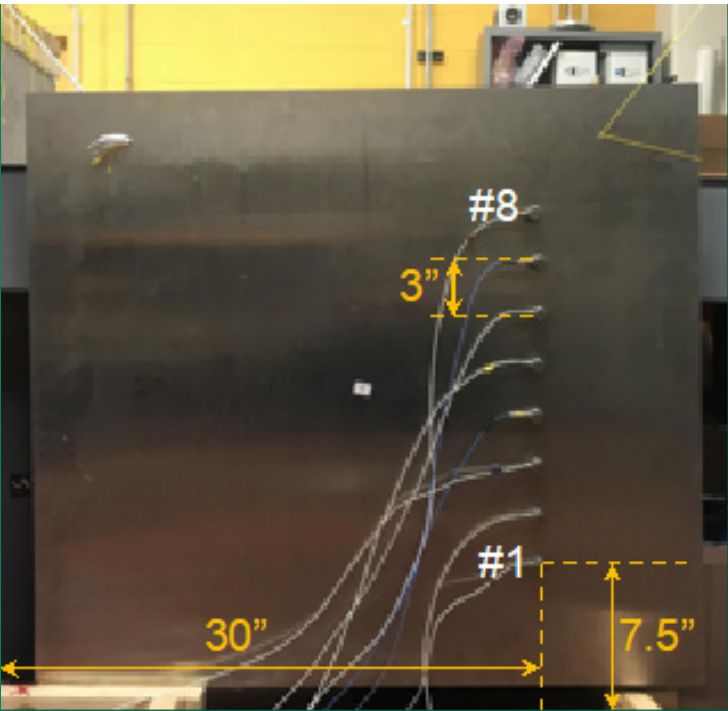
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polyethylene terephthalate recycling at U.S. Navy makerspaces to reduce plastic waste. For the project, the students will be making their own filament with recycled water bottles collected on campus.

"They started experimenting with standard filament, but wondered what would happen if they used something less standard. So, they take water bottles from campus and make their own filament material by sanitizing them, shredding them and melting them," George said.

The students will be working with their Carderock mentor on test products, predicting with proper tools what they think the answer is and being able to validate those answers.

"We are trying to be more proactive instead of reactive," George said. "With the COVID-19 pandemic, we are working with the universities to ensure that students can work on these projects virtually and still experience the benefits of participating in NEEC research."



Picture of the plate-vibration source-localization experimental setup utilizing eight accelerometers in a vertical line array. The dimensions are shown in inches.



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Louisiana State University

Dr. John Pojman, Chair of the Chemistry Department at Louisiana State University, has created an idea for a cure-on-demand non-skid coating that intends to revolutionize the world of applying paints.

Pojman's idea - Reduction of Volatile Organic Compounds through Development of Novel Next Generation Cure-On-Demand Ultra High Solid Non-Skid Coating - is part of the fiscal 2020 Naval Engineering Education Consortium (NEEC) projects at Naval Surface Warfare Center, Carderock Division.

Working alongside Pojman on this project are Jay Ong and Dr. Charles White, engineers in Carderock's Corrosion and Coatings Engineering Branch.

"We are developing an approach called cure-on-demand," Pojman said. "The idea is to create a product that doesn't need to be mixed with anything, which makes for a less error-prone environment, as well as creating less waste. Cure-on-demand coatings allow for controlled application, cleanup and curing of coatings without time delays or risk of improper cure conditions."

Conventional coatings begin the curing process immediately upon application due to solvent evaporation, have limited working times, and have long cure times. If conditions change after application, the coating can fail to cure correctly, and if working time is exceeded, the batch of coating is wasted. Pojman's technology is rationally designed to cure only when triggered by the applicator and has an unlimited working time. Instead of taking hours or potentially days to dry, this product dries within seconds to minutes when triggered. An advantage with the cure-on-demand product is that there is no mixing of products.

"The product will stay 'wet' or not cured until specifically triggered by heat," White said. "Instead of waiting 24 hours or longer for a full cure, Pojman's system will cure in seconds to minutes when the applicator decides."

The product, which utilizes a similar material to that of dental fillings, is heat activated instead of light.

"What I have enjoyed about working on this project is its wide-range of applicability," White said. "Almost every paint or coating the Navy uses suffers from similar problems and vulnerabilities. Developing the cure-on-demand technology and demonstrating the potential with non-skid is the first step to incorporating this technology to coatings elsewhere on the ship."

Furthermore, Ong said, "There is a high degree of interest right now in non-skid coatings for the exterior of surface ships. This is a good way to introduce Pojman's product to the fleet and show the promise of the quick surface turn-around time and cure time."

Proposed in the fall of 2019, experiments for the product commenced just before the COVID-19 pandemic.

"I helped design the process, and I oversee it alongside the Navy," Pojman said. "But the bulk of the physical work is being completed by a graduate student - Daniel Gary."

Gary is a full-time graduate student and paid research assistant to Pojman and was chosen to work on the project after showing significant interest in the product.

"Daniel is working on the project full time, and I have two part-time students. Daniel came to me and showed a lot of interest, so I brought him on board," Pojman said. "Back in May, he was in the lab quite a bit working on the project. Now with COVID going on, we have been using the down time to do a lot of research."

Pojman's goal is to have a working prototype within one year, though, due to COVID restrictions, the timeline may change. However, once the prototype is complete and evaluated by Carderock, Pojman will be able to proceed with expanding the product.

"This is an excellent opportunity for us," Pojman said. "There are some great scientific challenges that Daniel is able to experience. He couldn't be happier with this opportunity to work professionals in the real world."



Embry-Riddle Aeronautical University

Embry-Riddle Aeronautical University, a private university in Daytona Beach, Florida, is one of the seven current schools participating in the Naval Surface Warfare Center, Carderock Division-funded Naval Engineering Education Consortium (NEEC) projects.

The project, Robust Multi-Domain Situational Awareness through Sensor Fusion, is being overseen and directed by Dr. Eric Coyle, associate professor of mechanical engineering at Embry-Riddle. The Carderock mentor for this project is Dr. Timothy Coats, USV controls engineer resource at Carderock's Combatant Craft Division.

The overall goal of the project is to find ways to integrate sensor data from different domains - unmanned submarines and autonomous vehicles - gather and combine the data to be able to classify and detect underwater and surface components of vessels. They intend to be able to develop a comprehensive picture to be able to identify obstacles, as well as underwater threats.

"While our mechanical engineering program is relatively new - less than 20 years old - we have a well-developed robotics program," Coyle said. "When I came on board we increased our emphasis on research."

For nearly 15 years, Embry-Riddle has been involved with competitions sponsored by the Office of Naval Research. Such competitions include: RoboBoat, RoboSub and RobotX. Because of their involvement, they have been working on autonomy solutions to situational awareness to surface vehicles.

"Due to this involvement, we realized there was a commonality to data from the surface vehicles to the unmanned submarines, so we decided to collect data from both platforms and compare them," Coyle said.

It is at these competitions that Coyle was able to recruit his team of five graduate students to assist him with this project.

"I have an easy time choosing the right students," Coyle said. "With so many students involved with these different competitions, it is easy for me to see which ones have a true interest and backgrounds that fit."

One of these students - James Hendrickson - is in his final year of his graduate degree.

"I started on the RobotX platform and did all of the mission planning," Hendrickson said. "I had experience with sensor fusion, which helped me get involved with this project."

Embry-Riddle's 16 feet long, autonomous surface vessel was one of several to participate in an NSWCCD-funded NEEC project..

(Photo by Robotics Association at Embry-Riddle)

The project that Coyle and his graduate students are working on is a three-year process. The first year comprised of data collection, the second year - where they are currently at - is focused on data fusion, and the final year will consist of deploying their research and putting it to the test.

With the help of his graduate students, Coyle has developed a software that synchronizes data that is gathered by unmanned boats and underwater vehicles. The data is collected by taking multiple measurements of objects from different sensors. However, for the data to be valuable, it needs to be condensed into a single format.

"What we are doing, what needs to be done in order for the data to be valuable, is to turn the data into actionable intelligence that leverages the advantages of the data source that the Navy can use," Coyle said.

Furthermore, using the collected data, they are able to create multi-domain maps of the surrounding environment, providing situational awareness to the surface vehicles and unmanned submarines.

"By using these platforms, we'll be able to accurately detect obstacles and other hazardous objects of interest both above and below the surface," Hendrickson said. "This gives us a huge benefit in terms of how well we can classify different objects when they present themselves."

Later this year, during the second phase of this three-phase project, Coyle and his students have hopes of being able to further their research by utilizing unmanned aerial systems to collect data.

"We are looking to expand by using more real-time elements such as aerial platforms," Hendrickson said. "We'll use the camera images to get a surface level scan that can

give us even more opportunities to identify potential threats."

He went on to say, "Participating in this project has been extremely enjoyable and provided a great opportunity to focus on the research side of things."

Coyle is excited for the completion of the project, as he greatly wants to see their hard work put to use.

"It's not enough to know that what we've been working towards can happen," Coyle said. "We want to actually see it happen."



University of Rhode Island

One of the seven Naval Engineering Education Consortium (NEEC) projects at Naval Surface Warfare Center, Carderock Division is the Control of Autonomous Underwater Vehicles in Stratified Fluids and Near Surface Operations. This project is a collaboration between Carderock and the University of Rhode Island (URI).

Matthew Greytak, a control systems engineer in Carderock's Submarine Maneuvering and Control Division's Ship Control Branch, has been working with Dr. Stephen Licht, director of the Robotics Laboratory for Complex Underwater Environments at URI, on experiments to better control unmanned underwater vehicles while they

are at periscope depth - when the ship is completely underwater except its periscope.

Greytak, a Boston native and graduate of MIT, has been a Carderock employee for 10 years.

"In my division, we deal with submarine maneuvering and control," Greytak said. "We model and predict the maneuvering performance of subs. We then use those predictions to develop control algorithms."

Part of Greytak's job is to determine at what point - depth and speed - any failures with the submarine become unrecoverable.

"A fast moving submarine is like a fighter jet - it can do quick maneuvers and has a high level of control. A sub that is moving slowly is like a blimp - it has a lower level of control, and is more sensitive to environmental disturbances," Greytak said.

The experiments that Greytak and URI intend on completing will use small underwater vehicles in a URI tow tank to investigate automatic control strategies for low-speed, near-surface depth control.

"Suction forces pull a sub up towards the surface. At the same time, there are additional suction forces from sea waves. Both effects are much stronger the shallower you are," Greytak said. "We are looking for precise depth control in order to stay close to the surface, but not too close, at low speeds where the control surfaces are not very effective."

Greytak is currently looking to Licht and URI to help develop control techniques to use fins and a buoyancy system together to solve this issue.

The COVID-19 pandemic has temporarily halted the project since the URI lab spaces are currently closed. Greytak and Licht are working on contingency plans for graduate student development until the labs re-open.



